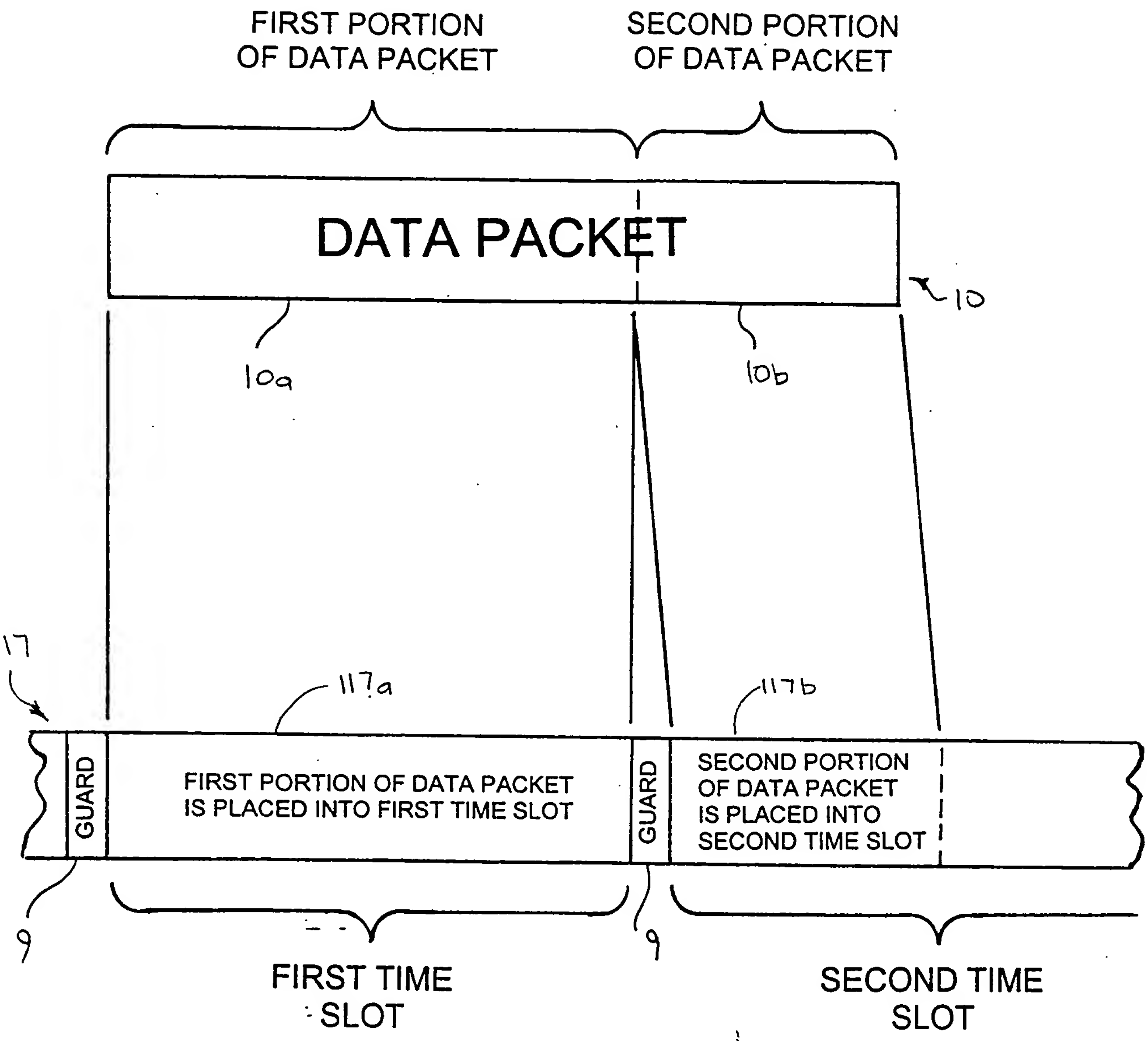


FIG. 1

DATA PACKET FRAGMENTATION IN A CABLE MODEM SYSTEM

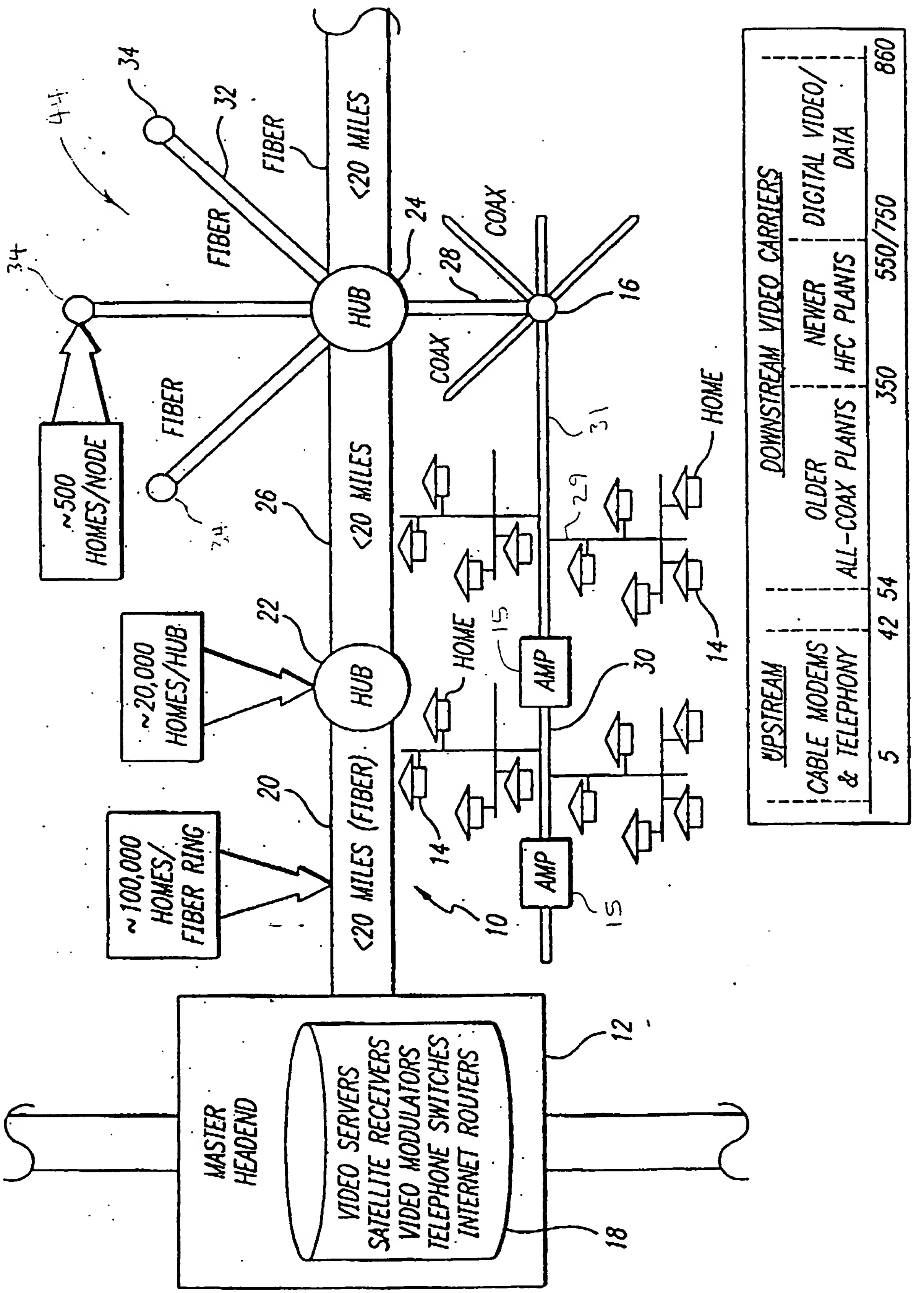


FIG. 2

DATA PACKET
FRAGMENTATION IN A
CABLE MODEM SYSTEM

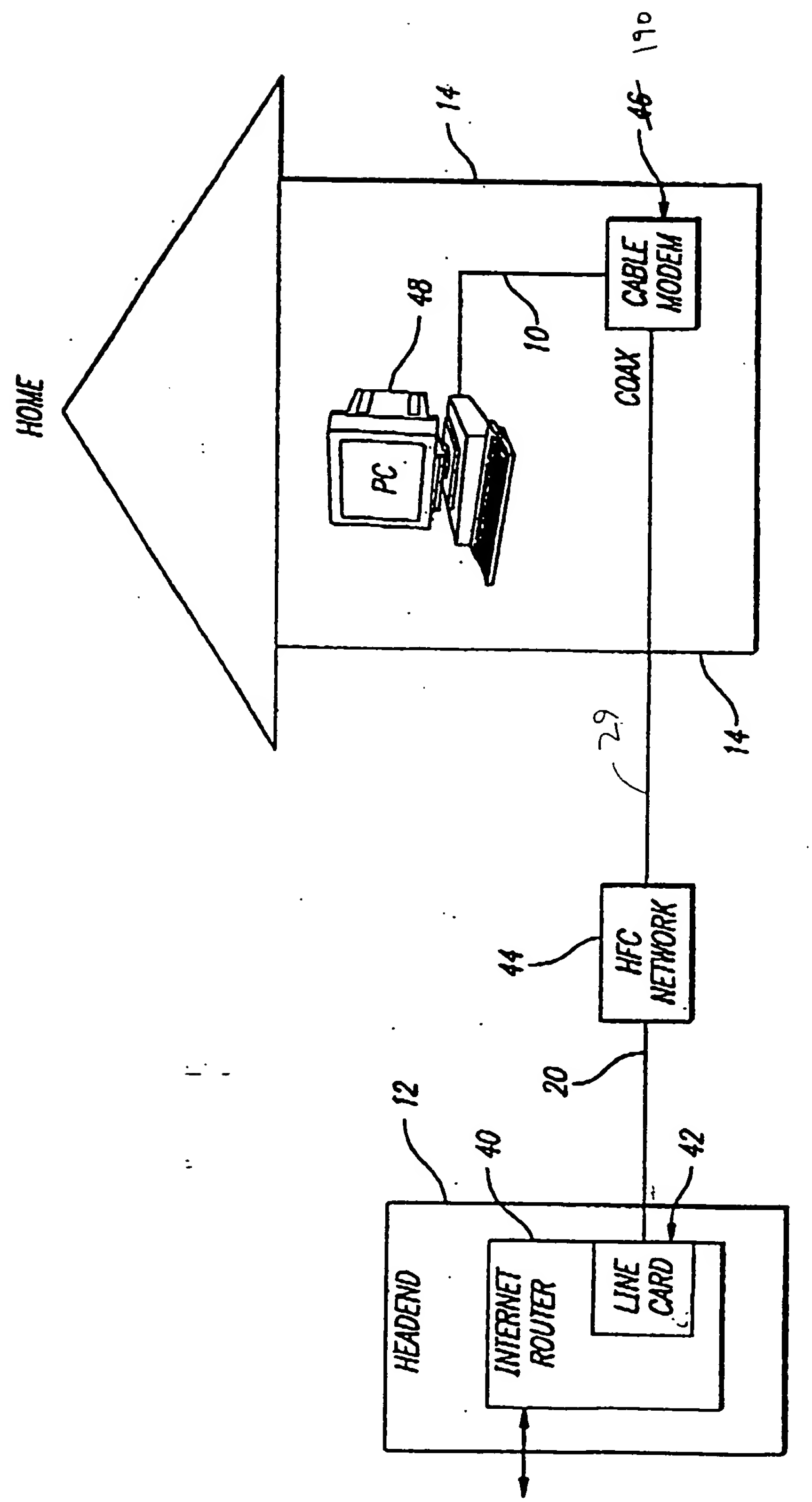


FIG. 3

DATA PACKET
FRAGMENTATION IN A
CABLE MODEM SYSTEM

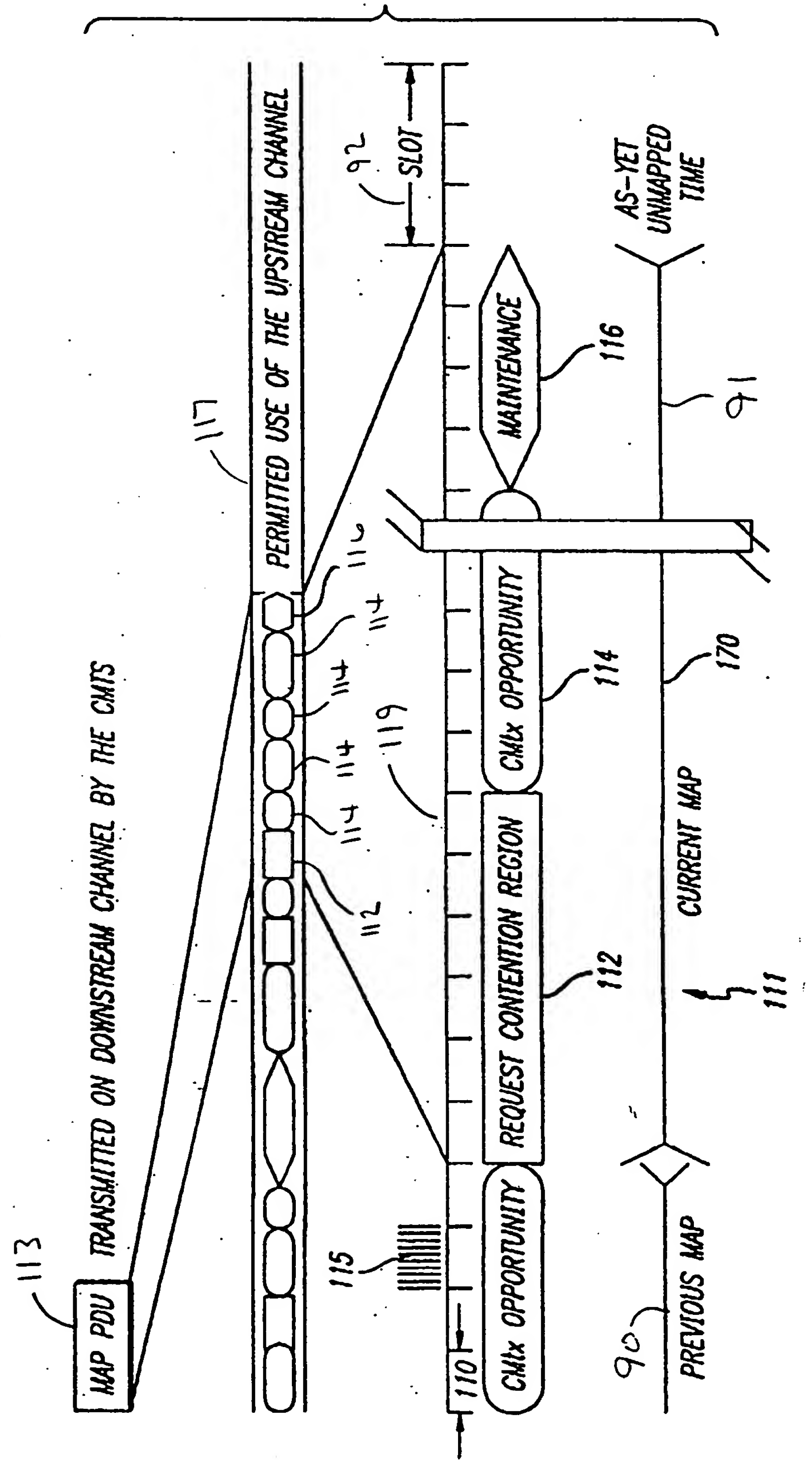


FIG. 4

DATA PACKET FRAGMENTATION IN A CABLE MODEM SYSTEM

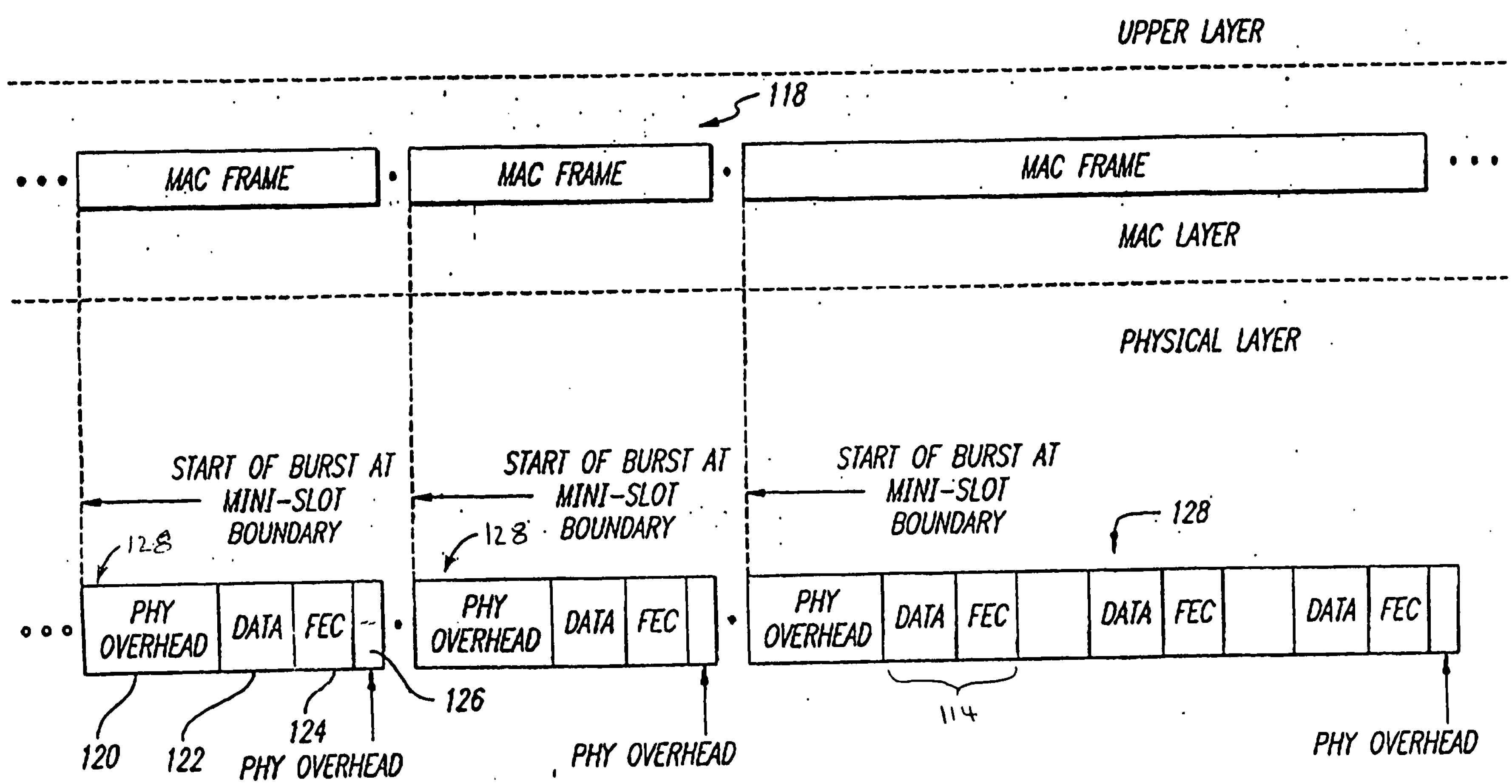


FIG. 5

DATA PACKET
FRAGMENTATION IN A
CABLE MODEM SYSTEM

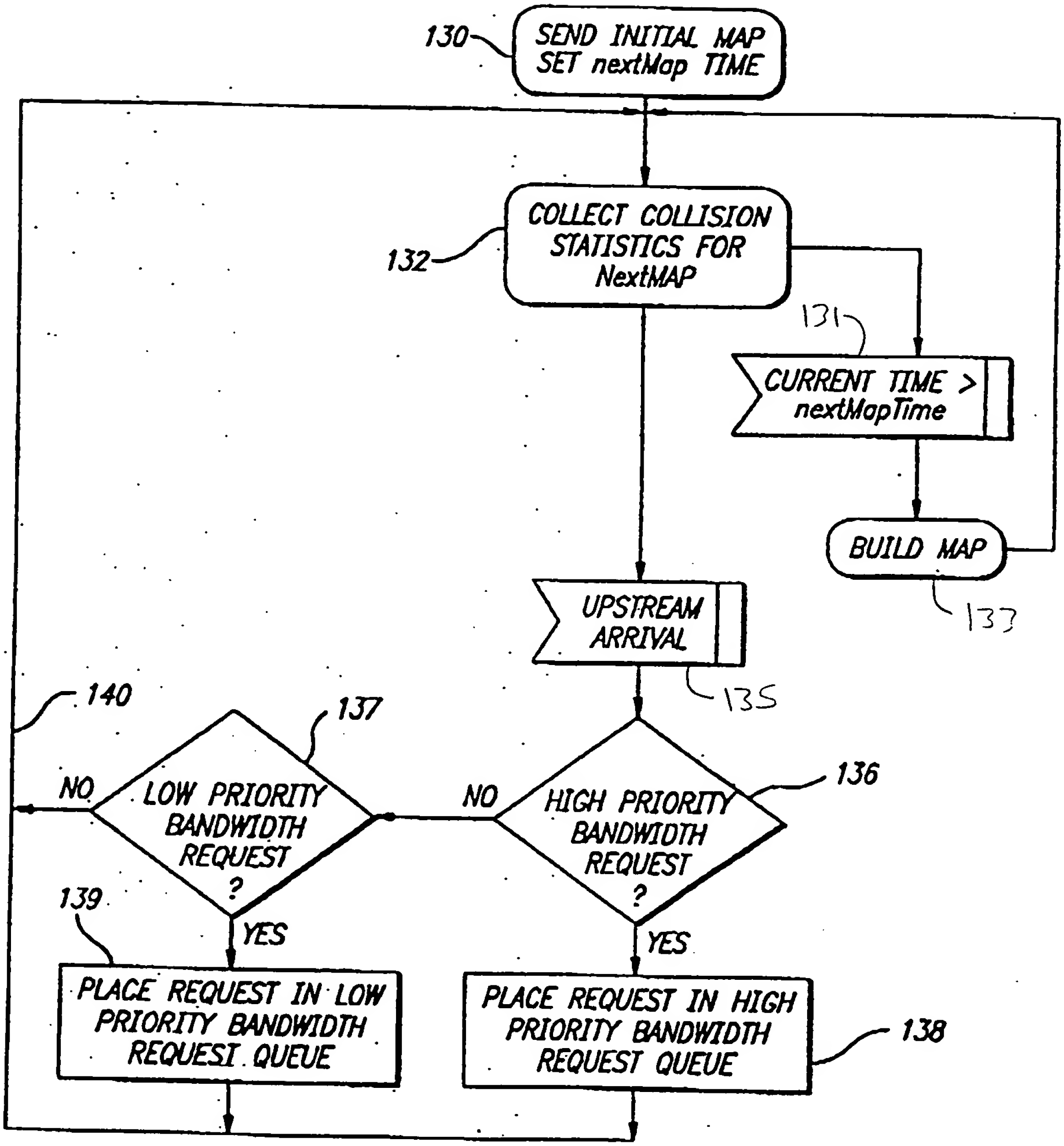


FIG. 6

DATA PACKET
FRAGMENTATION IN A
CABLE MODEM SYSTEM

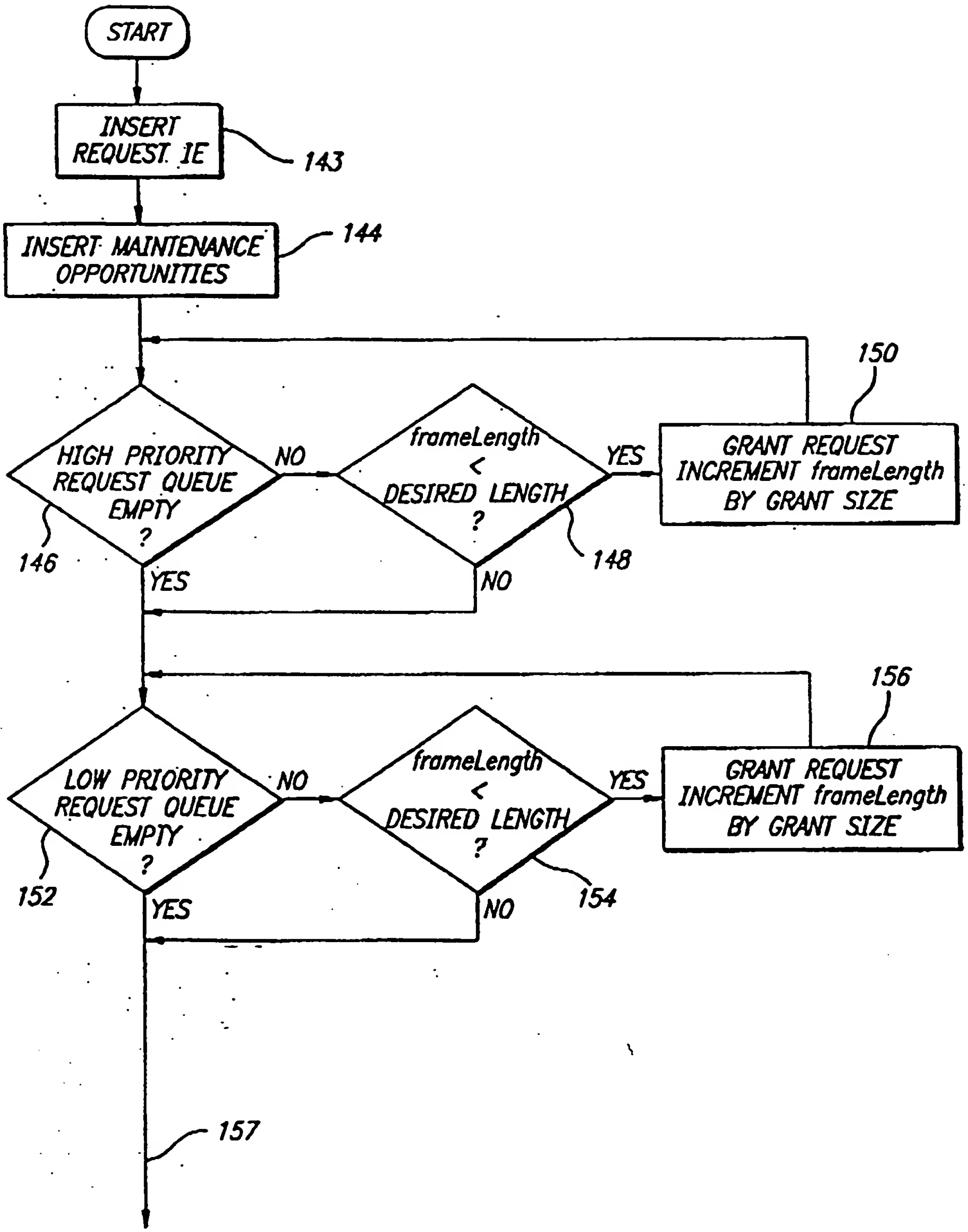


FIG. 7

DATA PACKET
FRAGMENTATION IN A
CABLE MODEM SYSTEM

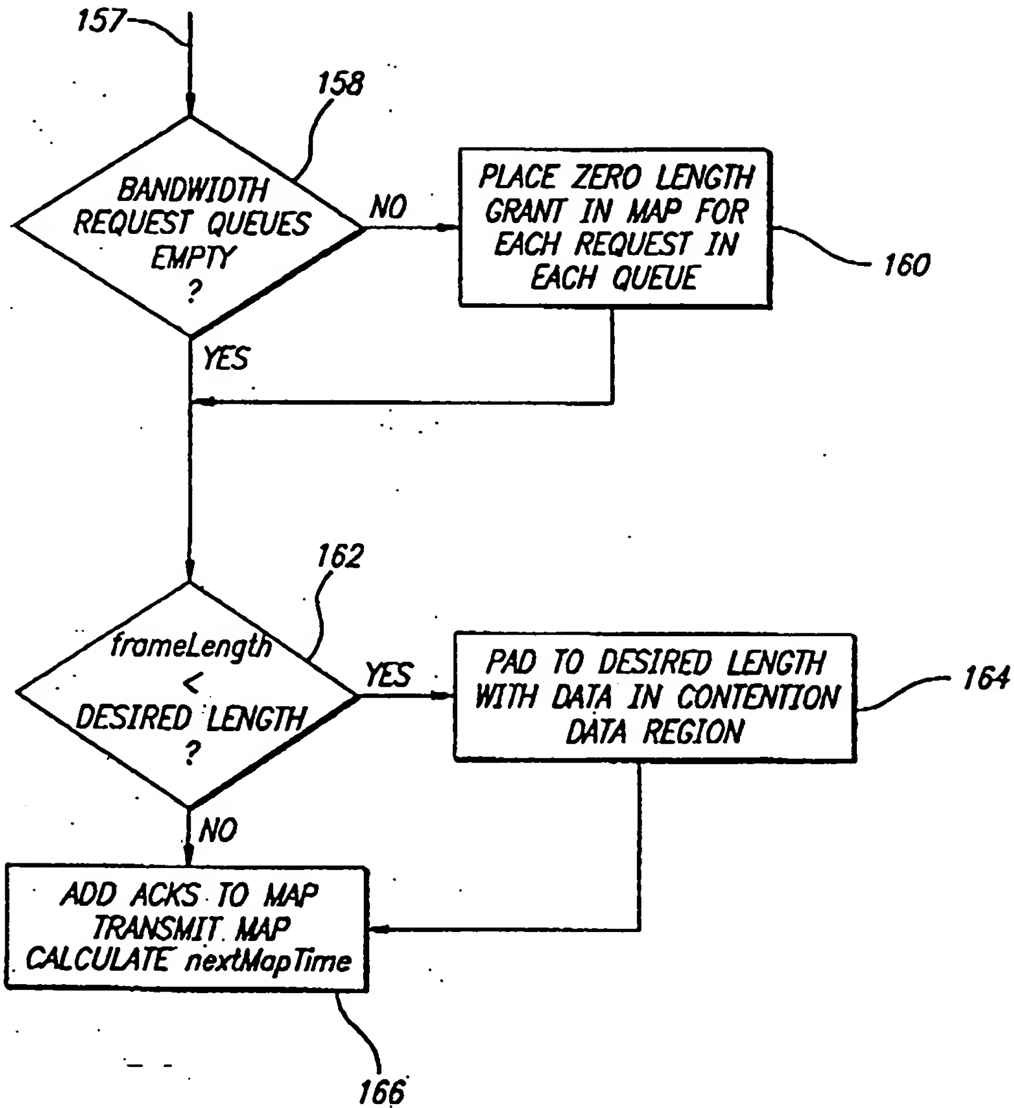


FIG. 8

DATA PACKET
FRAGMENTATION IN A
CABLE MODEM SYSTEM

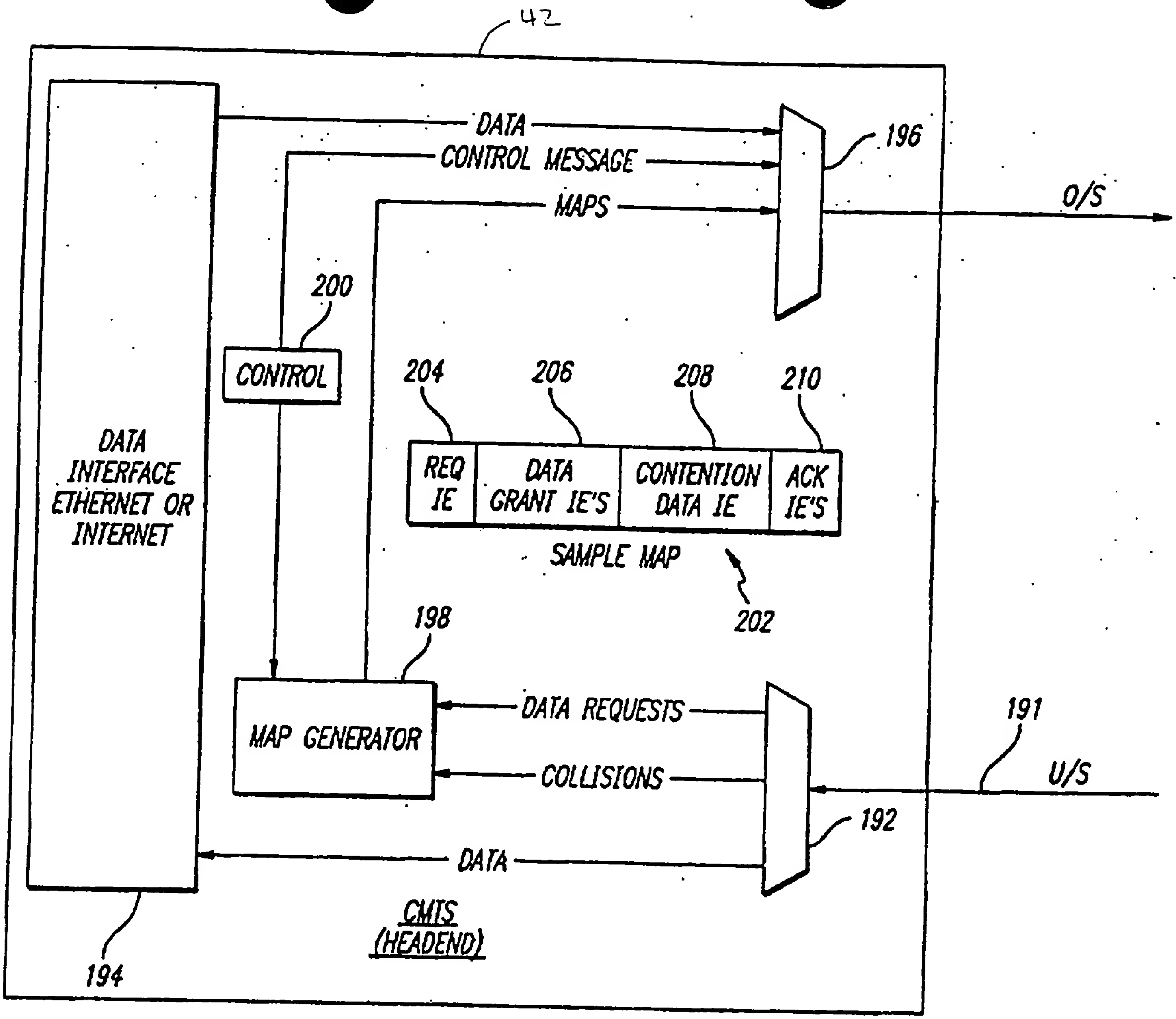


FIG. 9

DATA PACKET
FRAGMENTATION IN A
CABLE MODEM SYSTEM

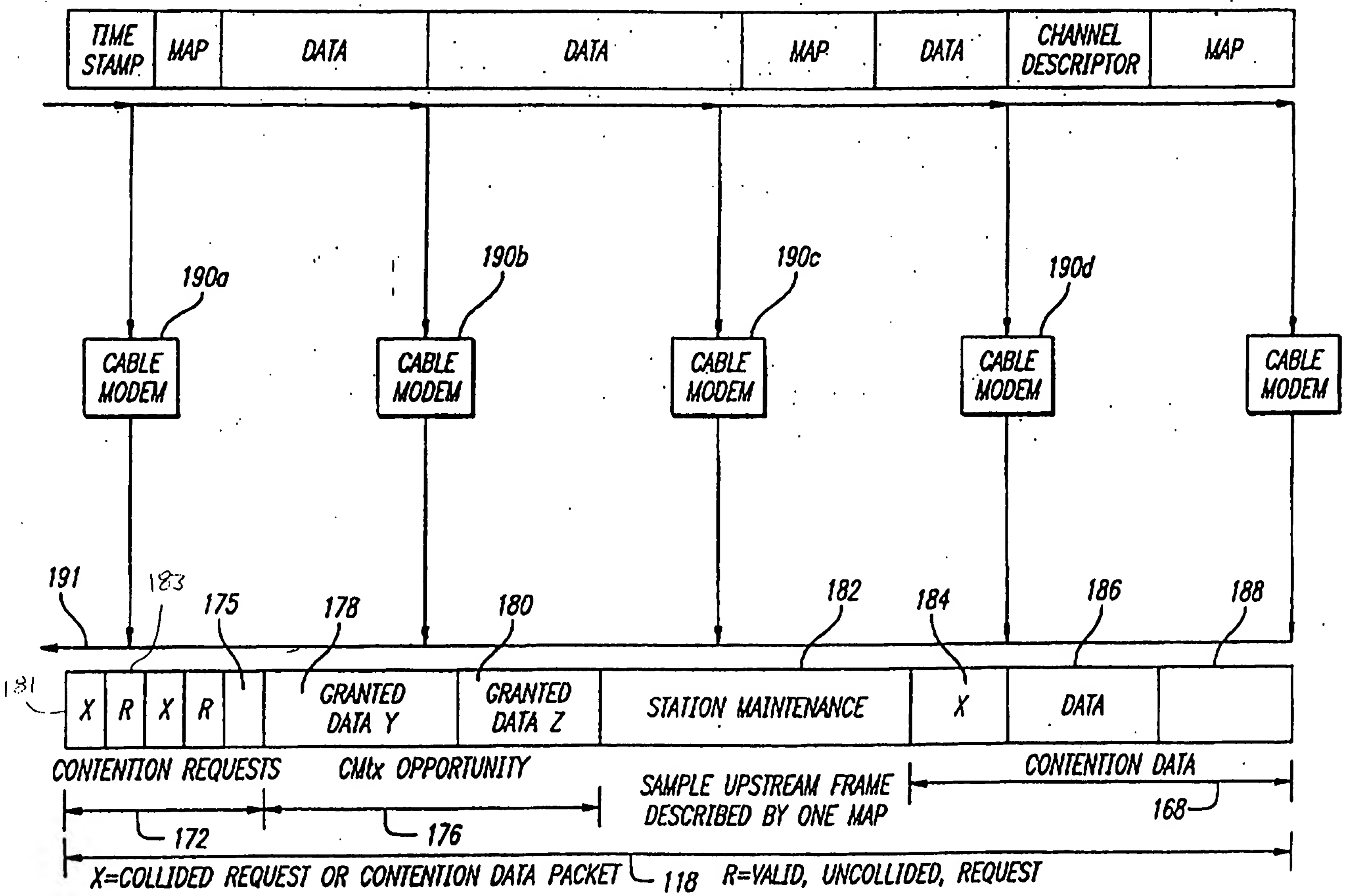


FIG. 10

DATA PACKET FRAGMENTATION IN A CABLE MODEM SYSTEM

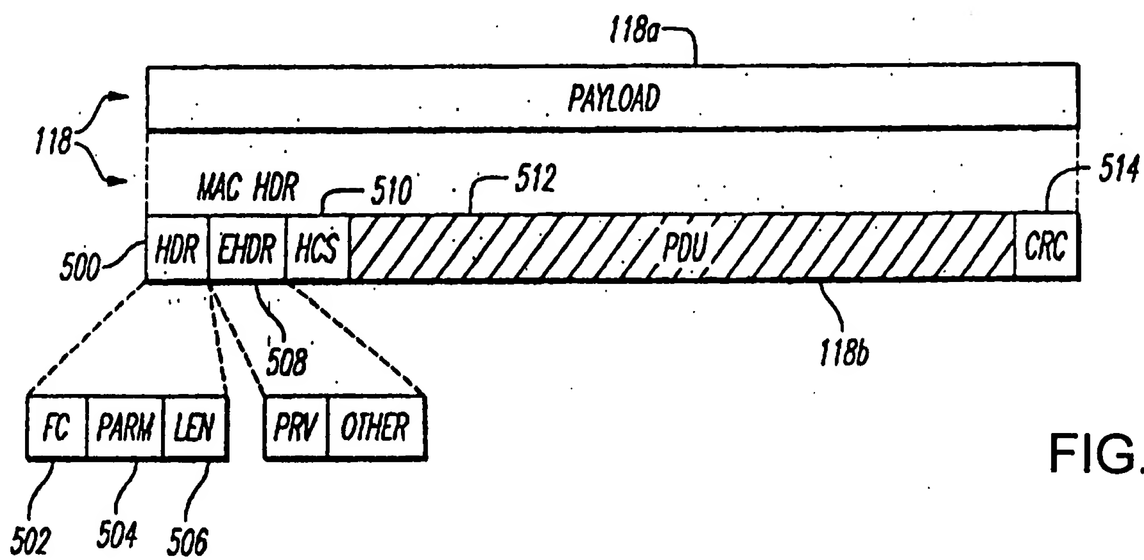


FIG. 11

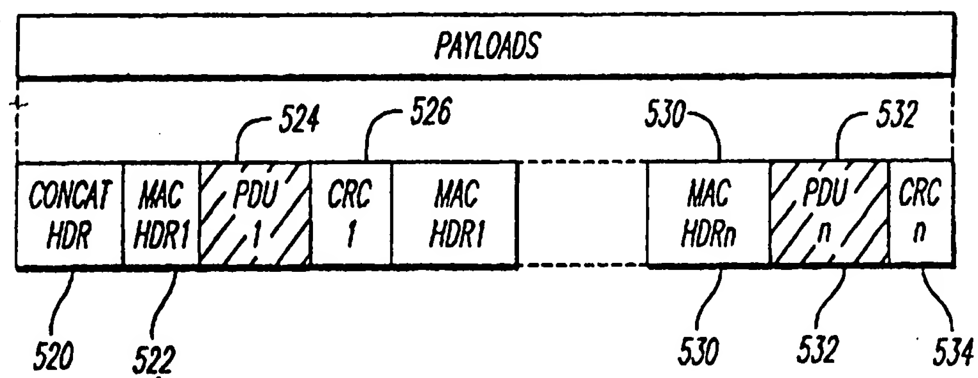


FIG. 12

DATA PACKET
FRAGMENTATION IN A
CABLE MODEM SYSTEM

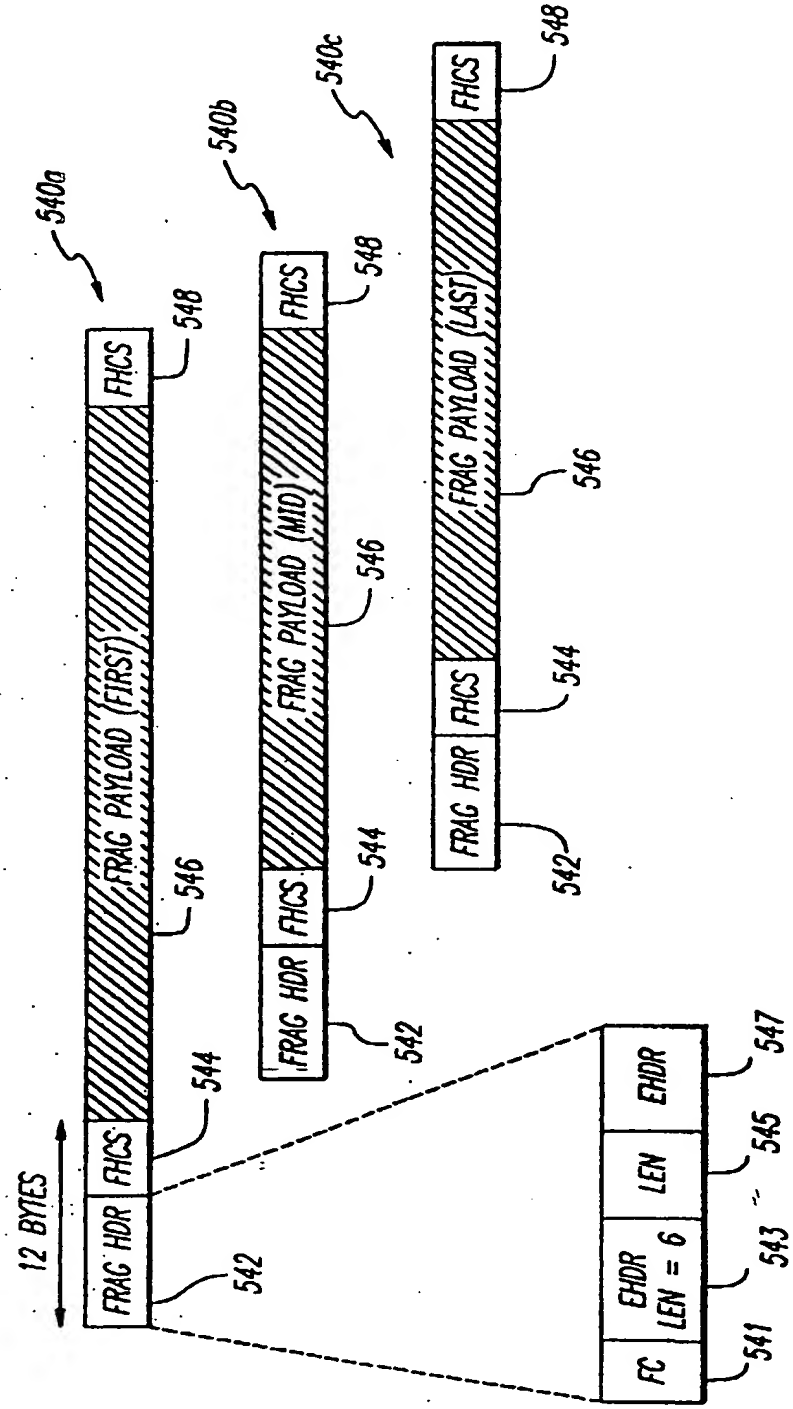


FIG. 13

DATA PACKET
FRAGMENTATION IN A
CABLE MODEM SYSTEM

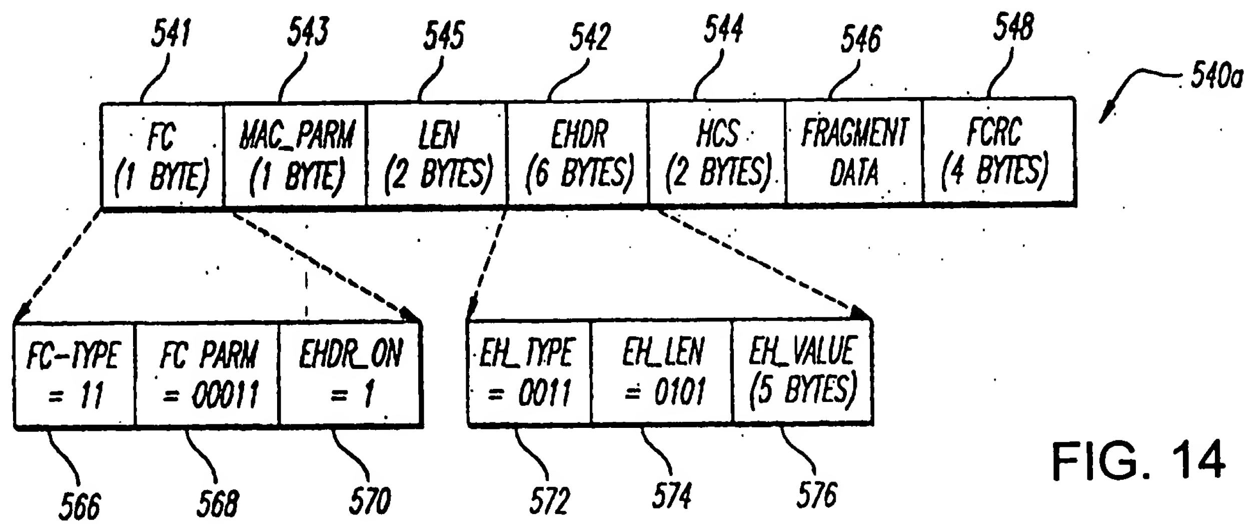


FIG. 14

FIELD	USAGE	SIZE
FC	FC_TYPE = 11;MAC-SPECIFIC HEADER FC_PARM [4:0] = 00011;FRAGMENTATION MAC HEADER EHDR_ON = 1;FRAGMENTATION EHDR FOLLOWS	8 BITS
MAC_PARM	ELEN = 6 BYTES;LENGTH OF FRAGMENTATION EHDR	8 BITS
LEN	LEN = n + 10;TOTAL LENGTH OF THIS FRAGMENT INCLUDING PAYLOAD, EHDR, FCRC	16 BITS

FIG. 15

DATA PACKET
FRAGMENTATION IN A
CABLE MODEM SYSTEM

FIELD	USAGE	SIZE	
EHDR	EH_TYPE=3;SAME TYPE AS BP_UP	4 BITS	6 BYTES
	EH_LEN=5;LENGTH OF THIS EHDR	4 BITS	
	KEY_SEQ;SAME AS IN BP_UP	4 BITS	
	VER=0001;VERSION NUMBER FOR THIS EHDR	4 BITS	
	ENABLE IF ENABLE=0, BPI DISABLED IF ENABLE=1, BPI ENABLED	1 BIT	
	TOGGLE BIT;SAME AS IN BP_UP	1 BIT	
	SID;SERVICE ID ASSOCIATED WITH THIS FRAGMENT	14 BITS	
	REQ;NUMBER OF MINI-SLOTS FOR A PIGGYBACK REQUEST	8 BITS	
	RESERVED;MUST BE SET TO ZERO	2 BITS	
	FIRST_FRAG;SET TO ONE FOR FIRST FRAGMENT ONLY	1 BIT	
	LAST_FRAG;SET TO ONE FOR LAST FRAGMENT ONLY	1 BIT	
	FRAG_SEQ;FRAGMENT SEQUENCE COUNT, INCREMENTED FOR EACH FRAGMENT, SET TO ZERO FOR FIRST FRAGMENT	4 BITS	
HCS	MAC HEADER CHECK SEQUENCE		2 BYTES
FRAGMENT DATA	FRAGMENT PAYLOAD;PORTION OF TOTAL MAC PDU BEING SENT		n BYTES
FCRC	CRC ACROSS FRAGMENT PAYLOAD		4 BYTES
	LENGTH OF A MAC FRAGMENT FRAME	n + 16 BYTES	

FIG. 16

DATA PACKET
FRAGMENTATION IN A
CABLE MODEM SYSTEM

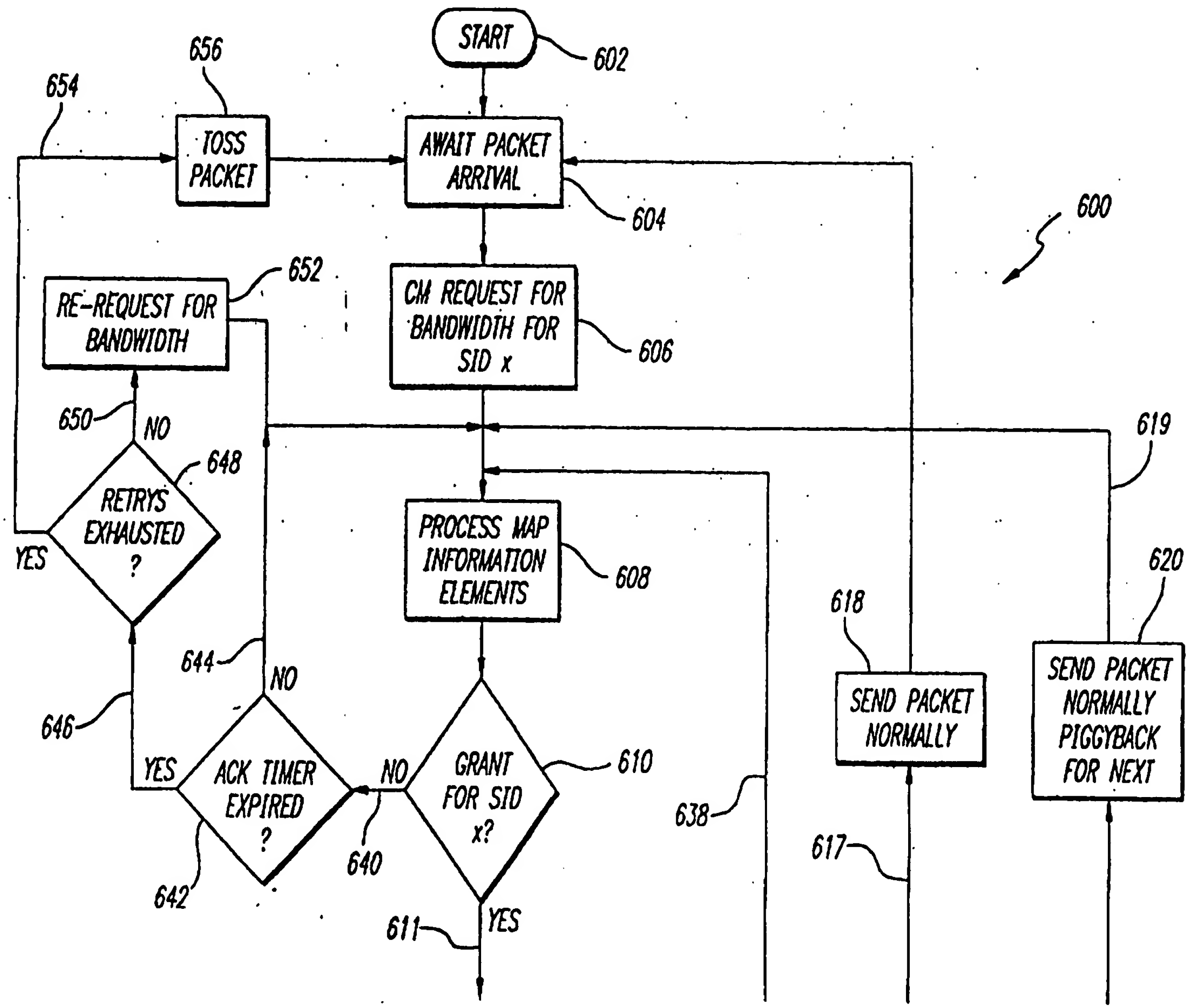


FIG. 17

DATA PACKET FRAGMENTATION IN A CABLE MODEM SYSTEM

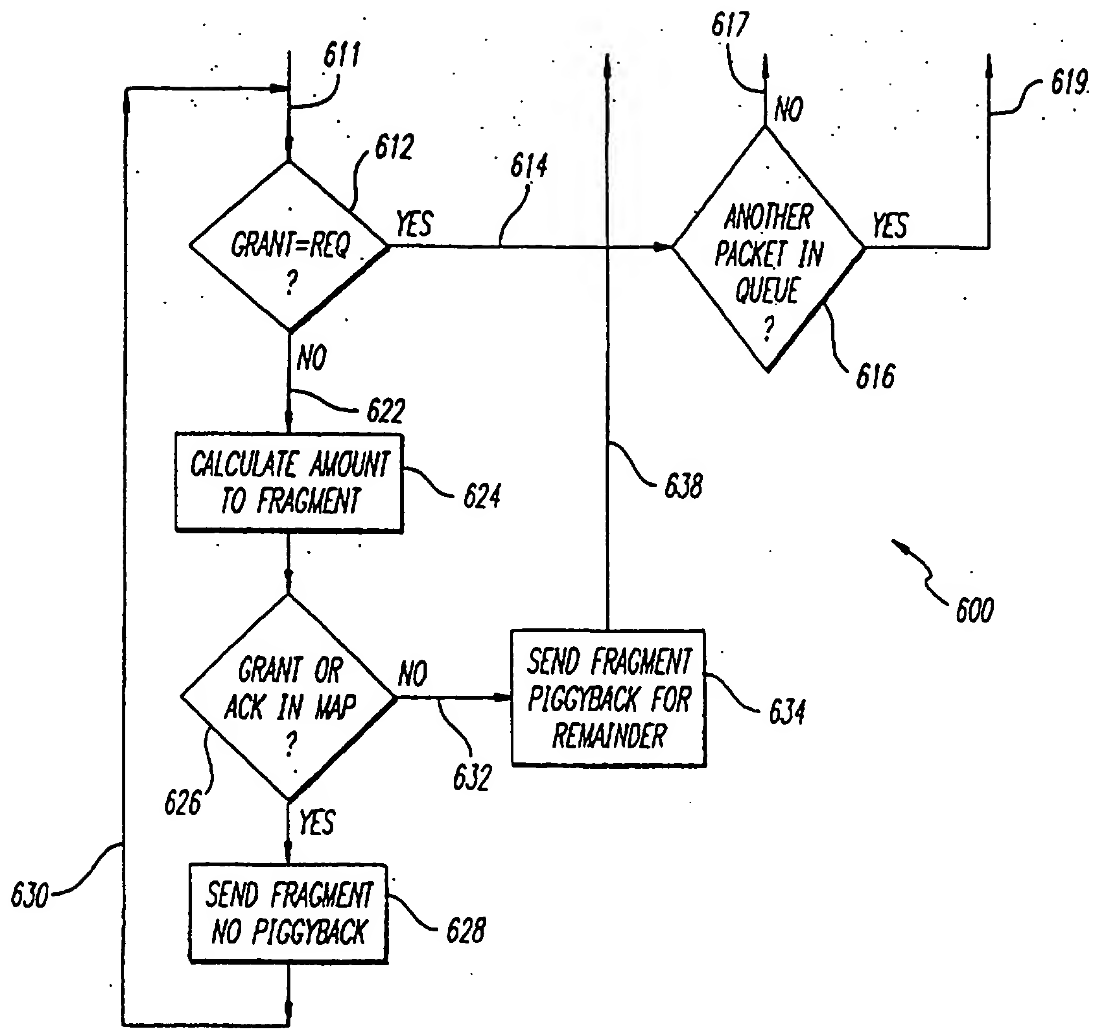


FIG. 18

DATA PACKET
FRAGMENTATION IN A
CABLE MODEM SYSTEM

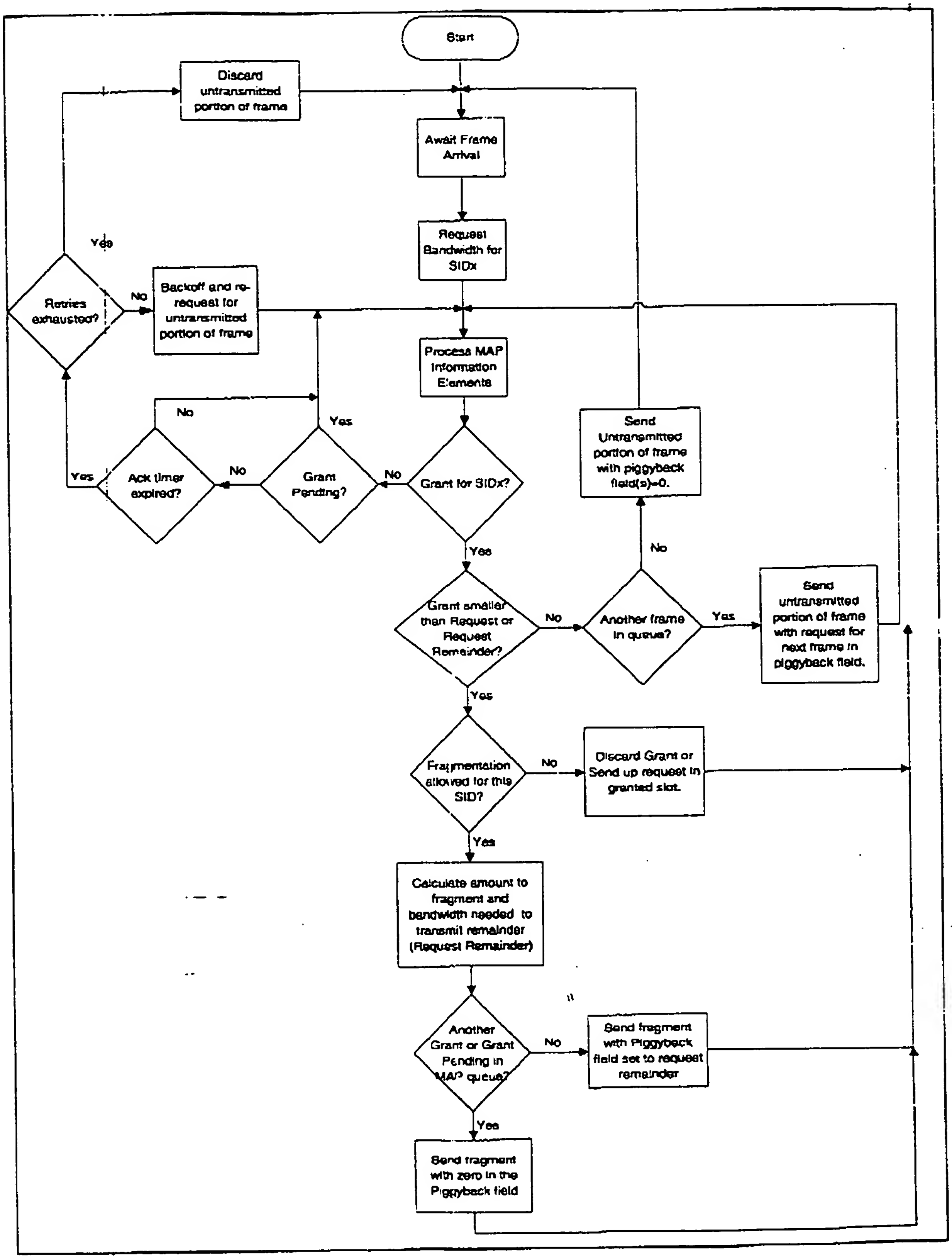


FIG. 19

DATA PACKET FRAGMENTATION IN A CABLE MODEM SYSTEM

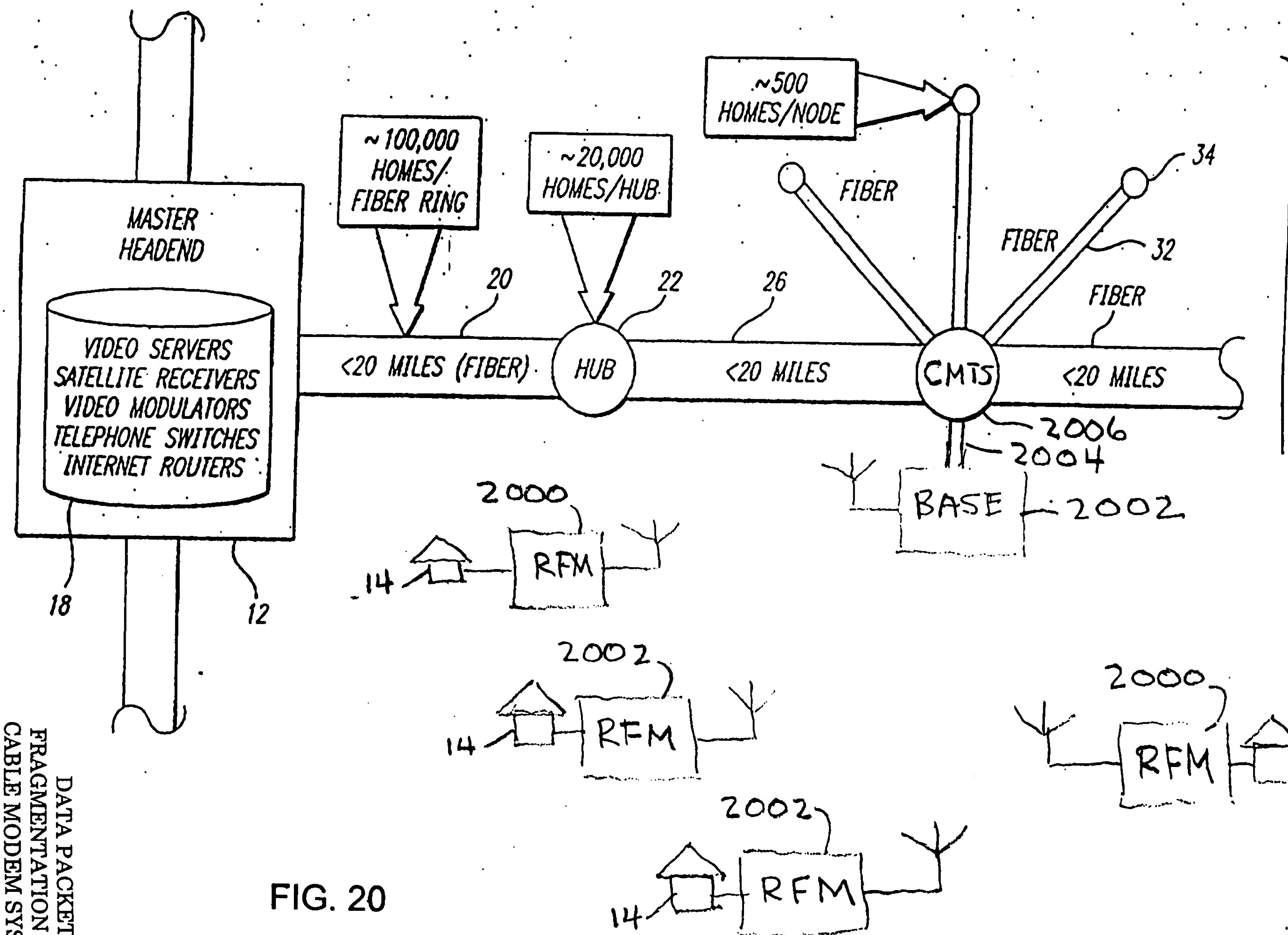


FIG. 20

DATA PACKET
FRAGMENTATION IN A
CABLE MODEM SYSTEM

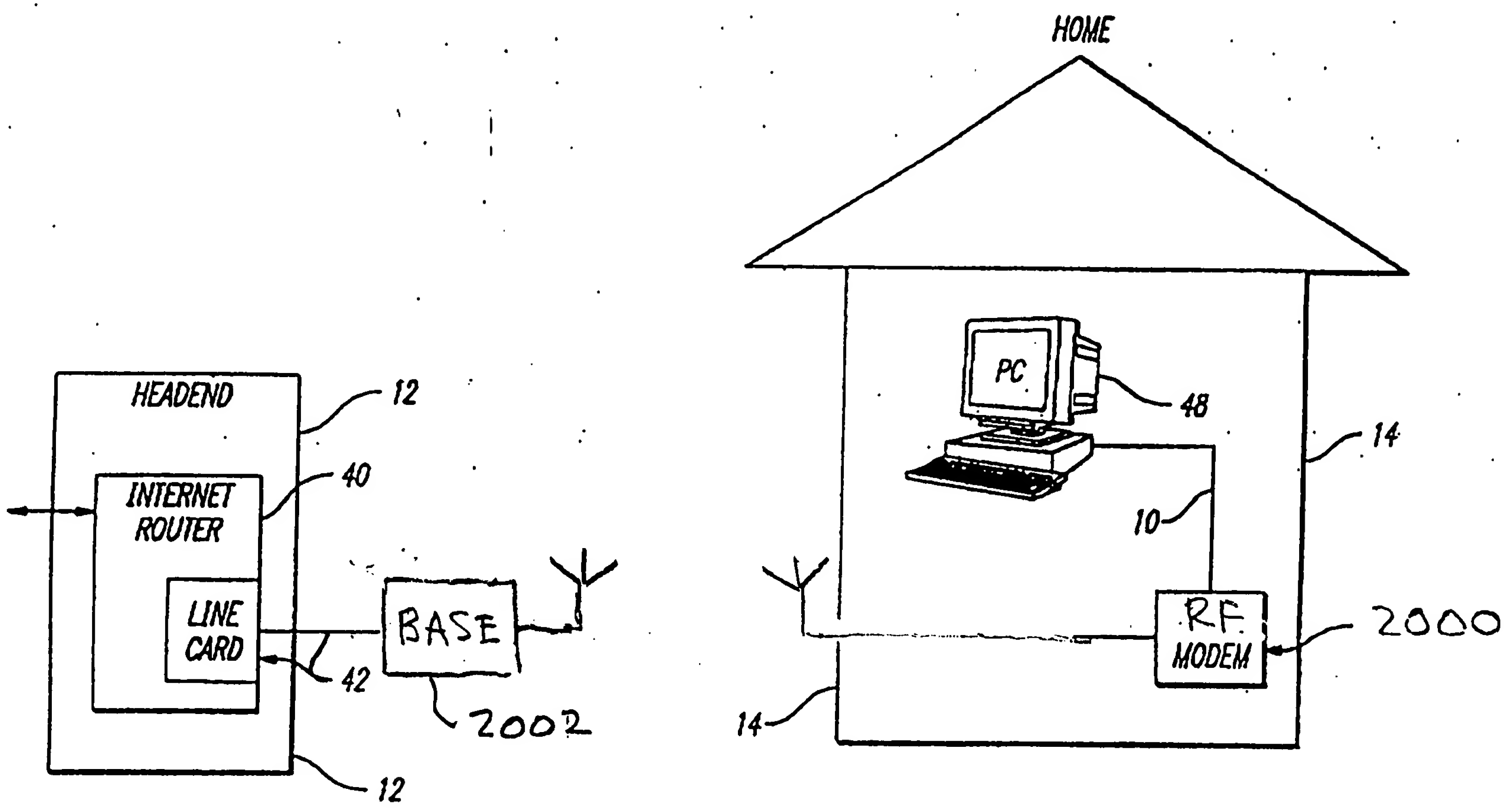


FIG. 21

DATA PACKET FRAGMENTATION IN A CABLE MODEM SYSTEM

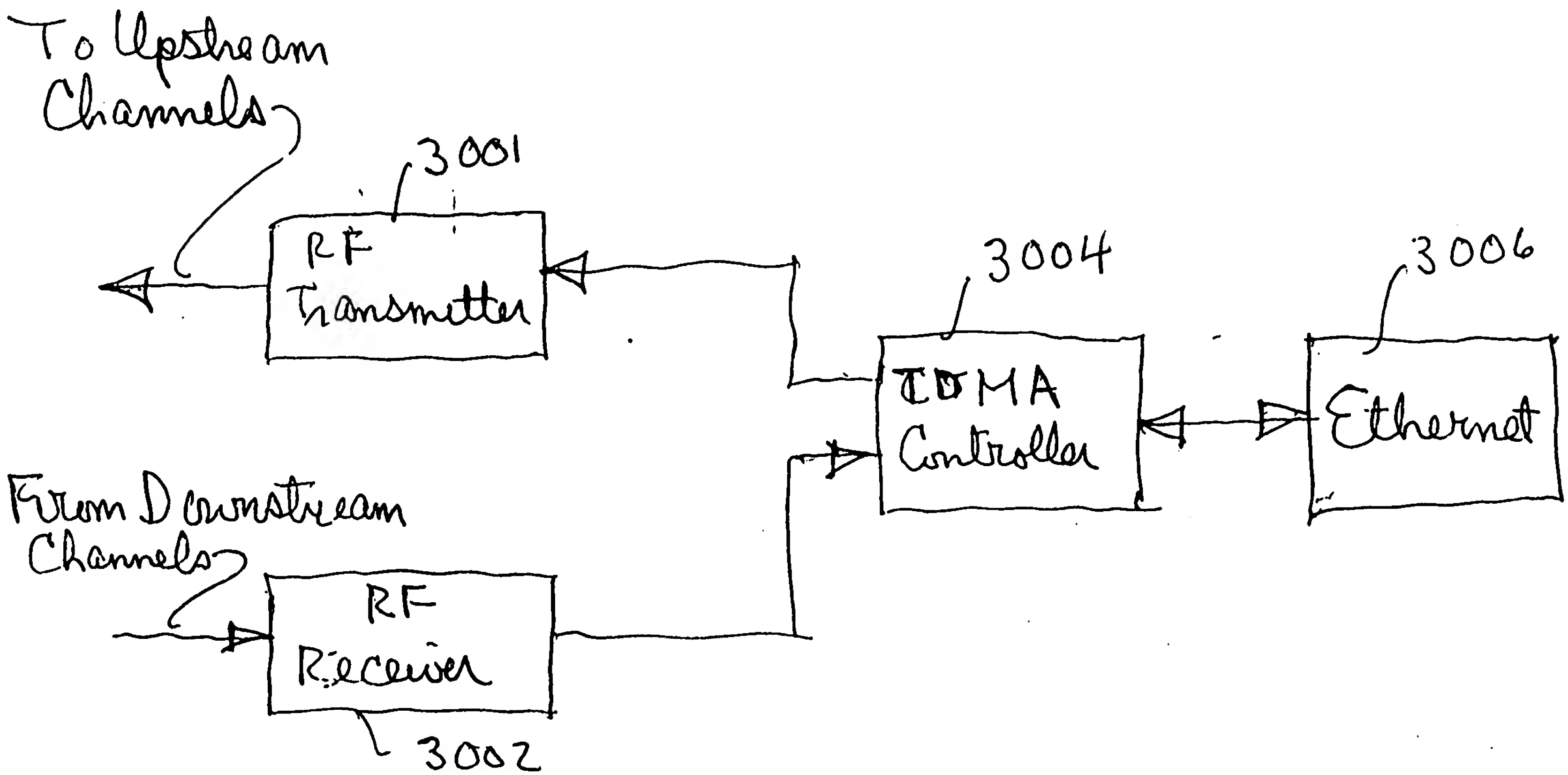


FIG. 22

DATA PACKET
FRAGMENTATION IN A
CABLE MODEM SYSTEM

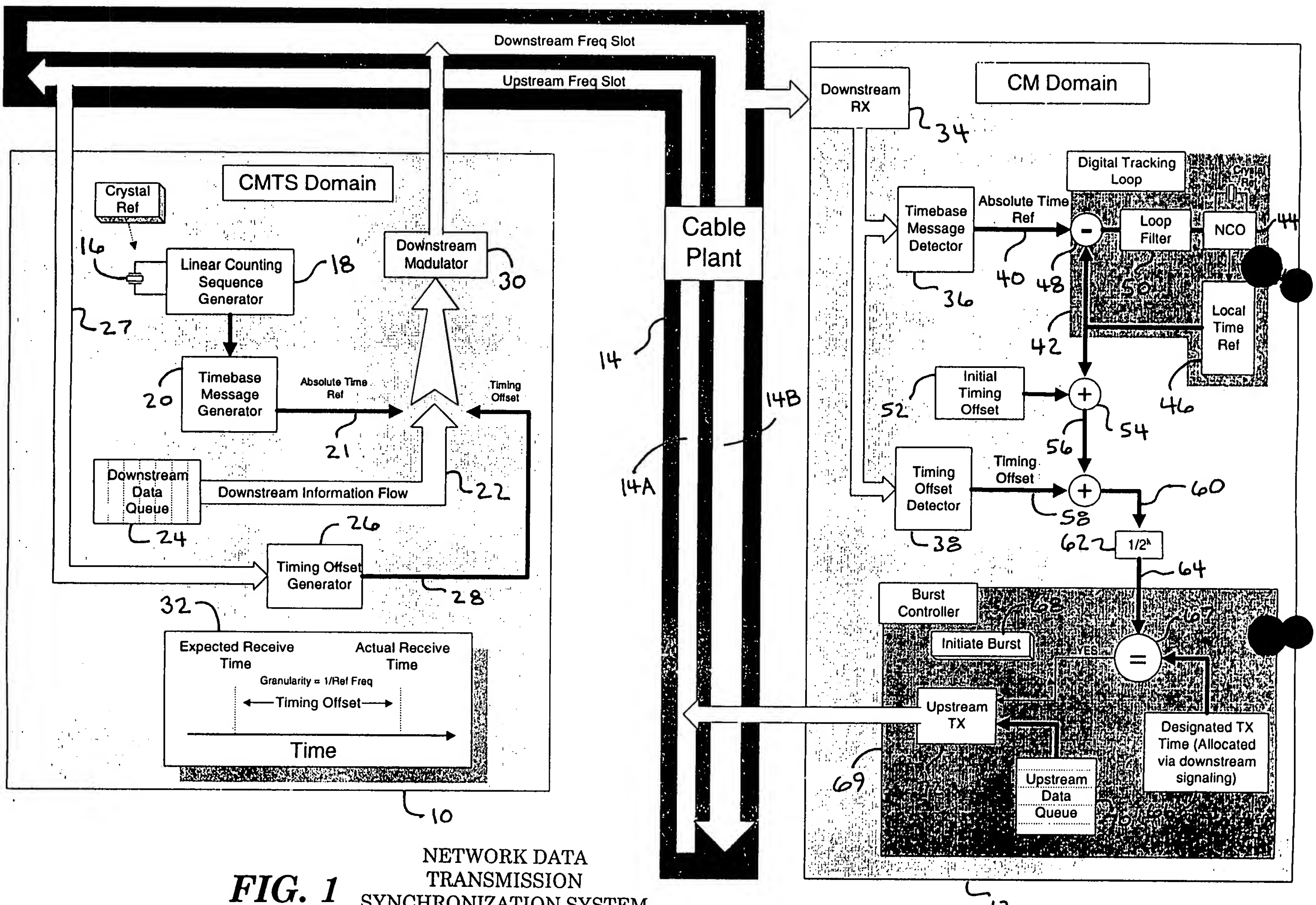


FIG. 1 NETWORK DATA TRANSMISSION SYNCHRONIZATION SYSTEM AND METHOD

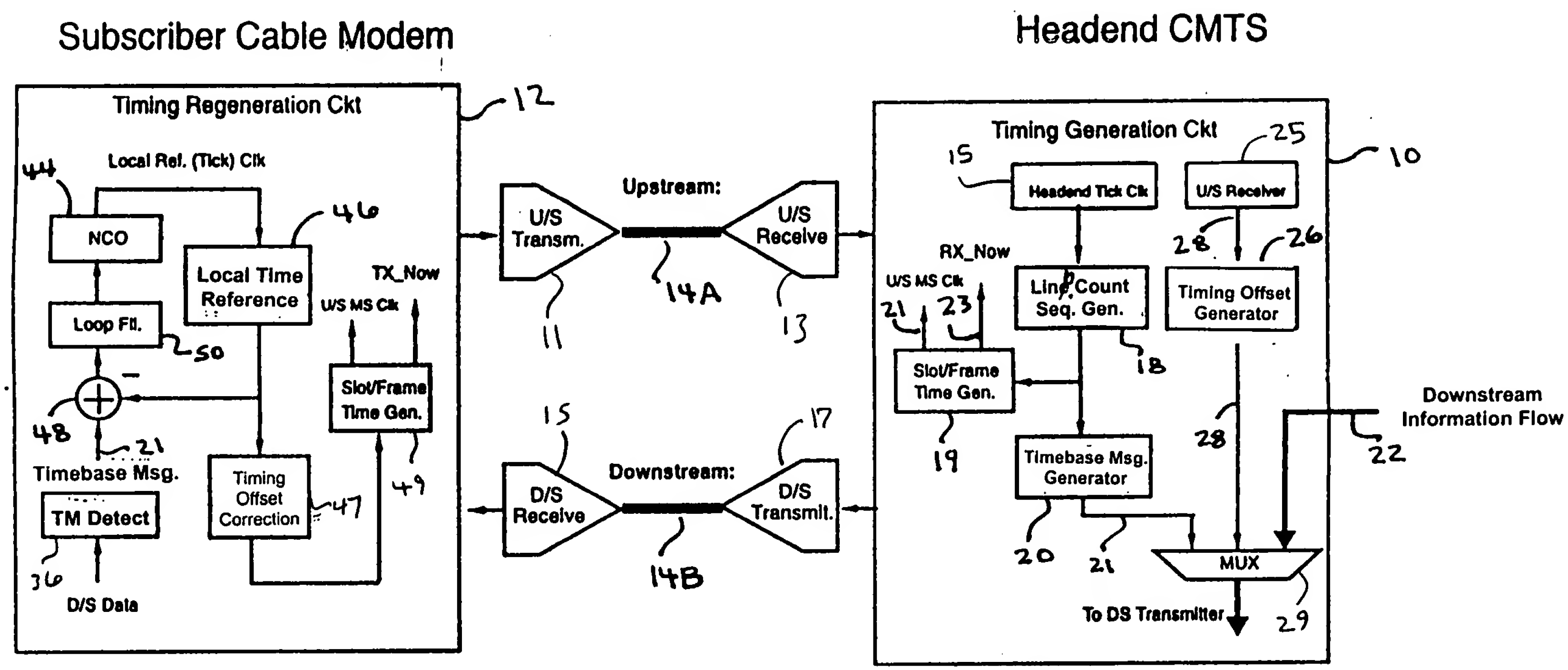


FIG. 2

NETWORK DATA
TRANSMISSION
SYNCHRONIZATION SYSTEM
AND METHOD

66620T " T280E460

NETWORK DATA
TRANSMISSION
SYNCHRONIZATION SYSTEM
AND METHOD

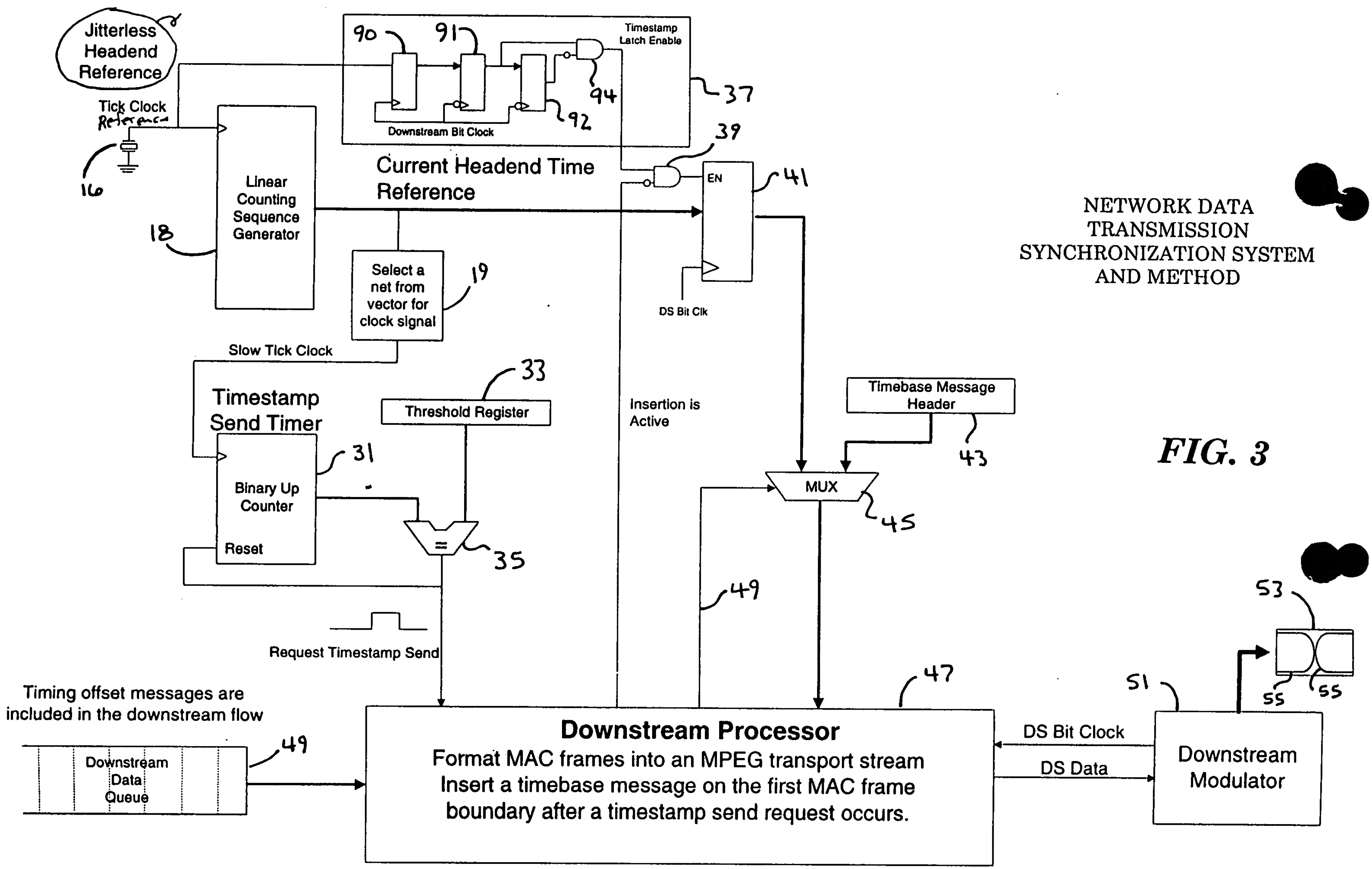


FIG. 3

NETWORK DATA
TRANSMISSION
SYNCHRONIZATION SYSTEM
AND METHOD

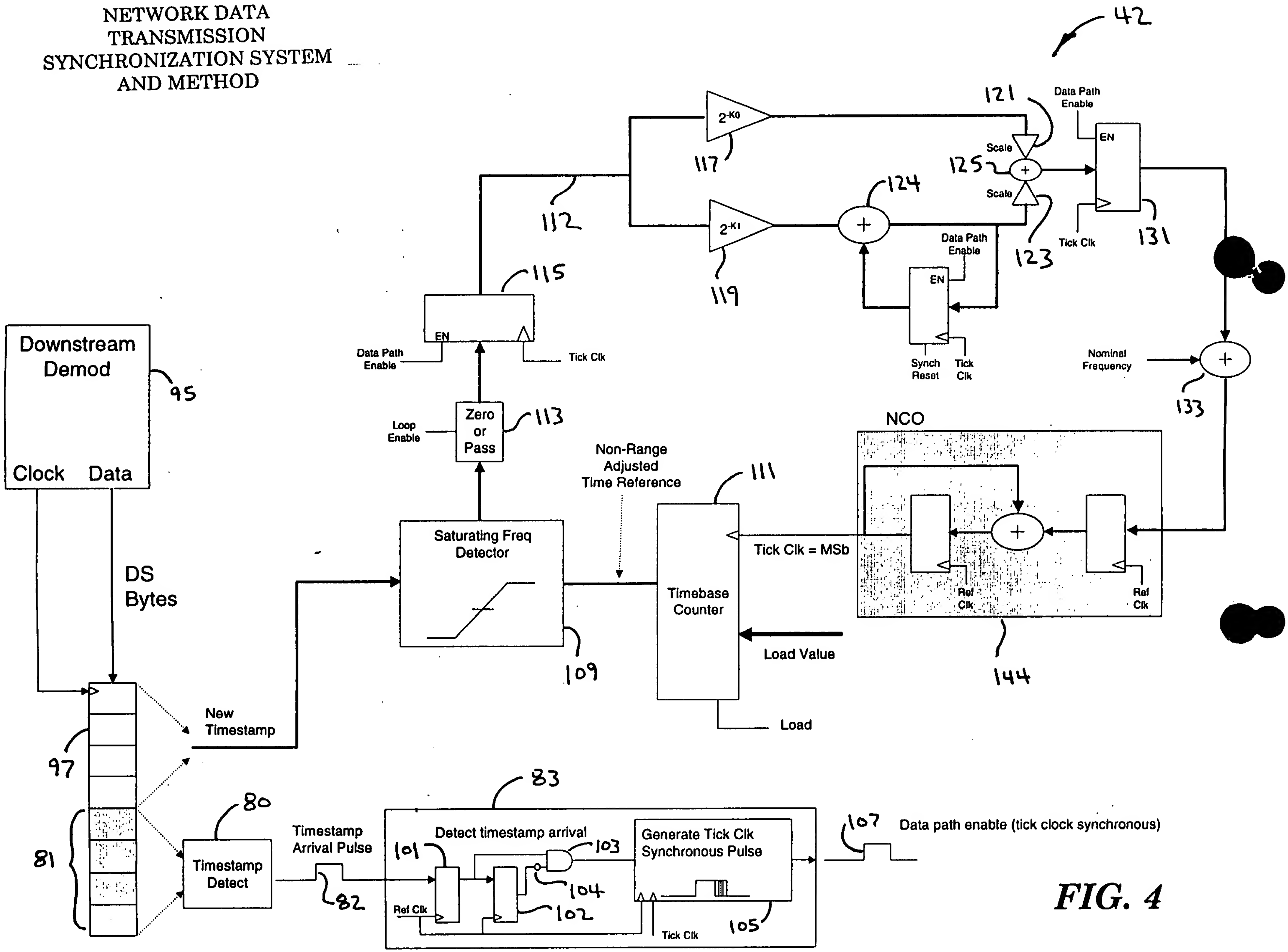
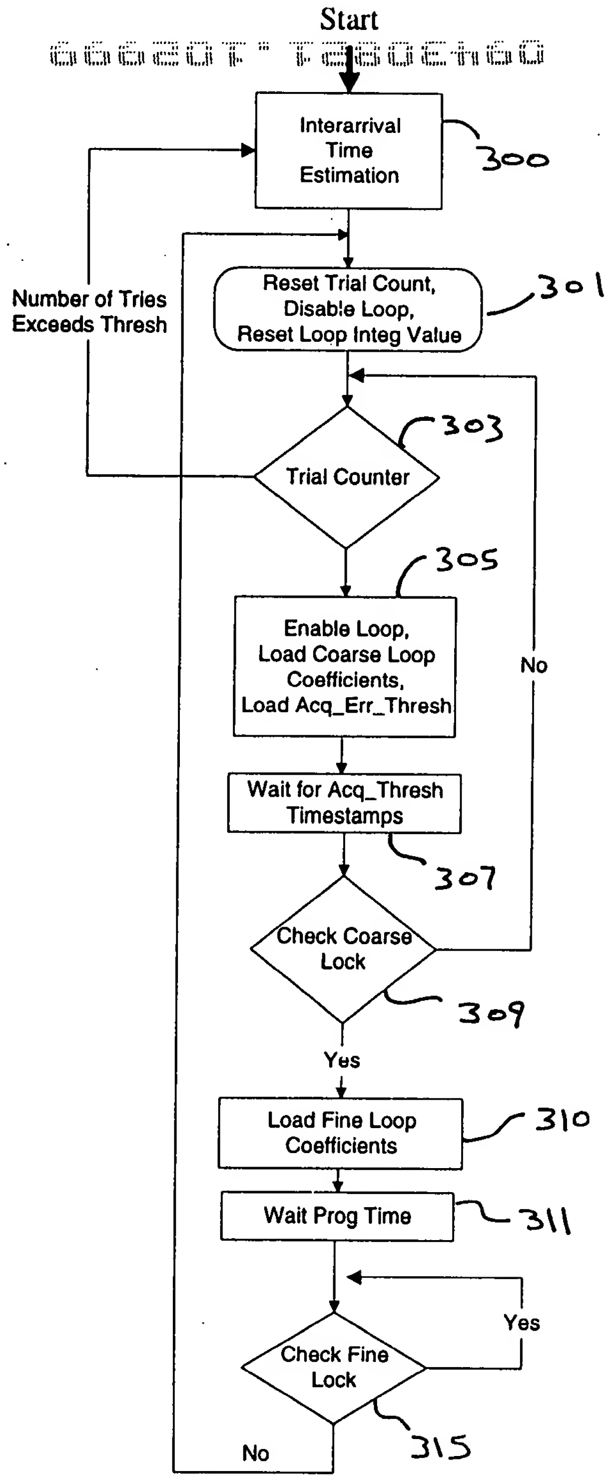


FIG. 4

Update Rate	Coarse Coeffs	Fine Coefficients
1kHz (1ms)	$K0 = 2^{-11}$ $K1 = 2^{-15}$ (BW=50Hz)	$K0 = 2^{-16}$ $K1 = 2^{-25}$ (BW=1Hz)
300Hz (3.3ms)	$K0 = 2^{-12}$ $K1 = 2^{-15}$ (BW=20Hz)	$K0 = 2^{-16}$ $K1 = 2^{-23}$ (BW=1Hz)
100Hz (10ms)	$K0 = 2^{-13}$ $K1 = 2^{-16}$ (BW=10Hz)	$K0 = 2^{-16}$ $K1 = 2^{-22}$ (BW=1Hz)
50Hz (20ms)	$K0 = 2^{-14}$ $K1 = 2^{-17}$ (BW=5Hz)	$K0 = 2^{-16}$ $K1 = 2^{-21}$ (BW=1Hz)
30Hz (33ms)	$K0 = 2^{-15}$ $K1 = 2^{-18}$ (BW=3Hz)	$K0 = 2^{-17}$ $K1 = 2^{-21}$ (BW=1Hz)
10Hz (100ms)	$K0 = 2^{-17}$ $K1 = 2^{-20}$ (BW=1Hz)	$K0 = 2^{-17}$ $K1 = 2^{-20}$ (BW=1Hz)
5Hz (200ms)	$K0 = 2^{-18}$ $K1 = 2^{-20}$ (BW=1Hz)	$K0 = 2^{-18}$ $K1 = 2^{-20}$ (BW=1Hz)

FIG. 5

NETWORK DATA
TRANSMISSION
SYNCHRONIZATION SYSTEM
AND METHOD



NETWORK DATA TRANSMISSION SYNCHRONIZATION SYSTEM AND METHOD

FIG. 6

66620T"T280EH60

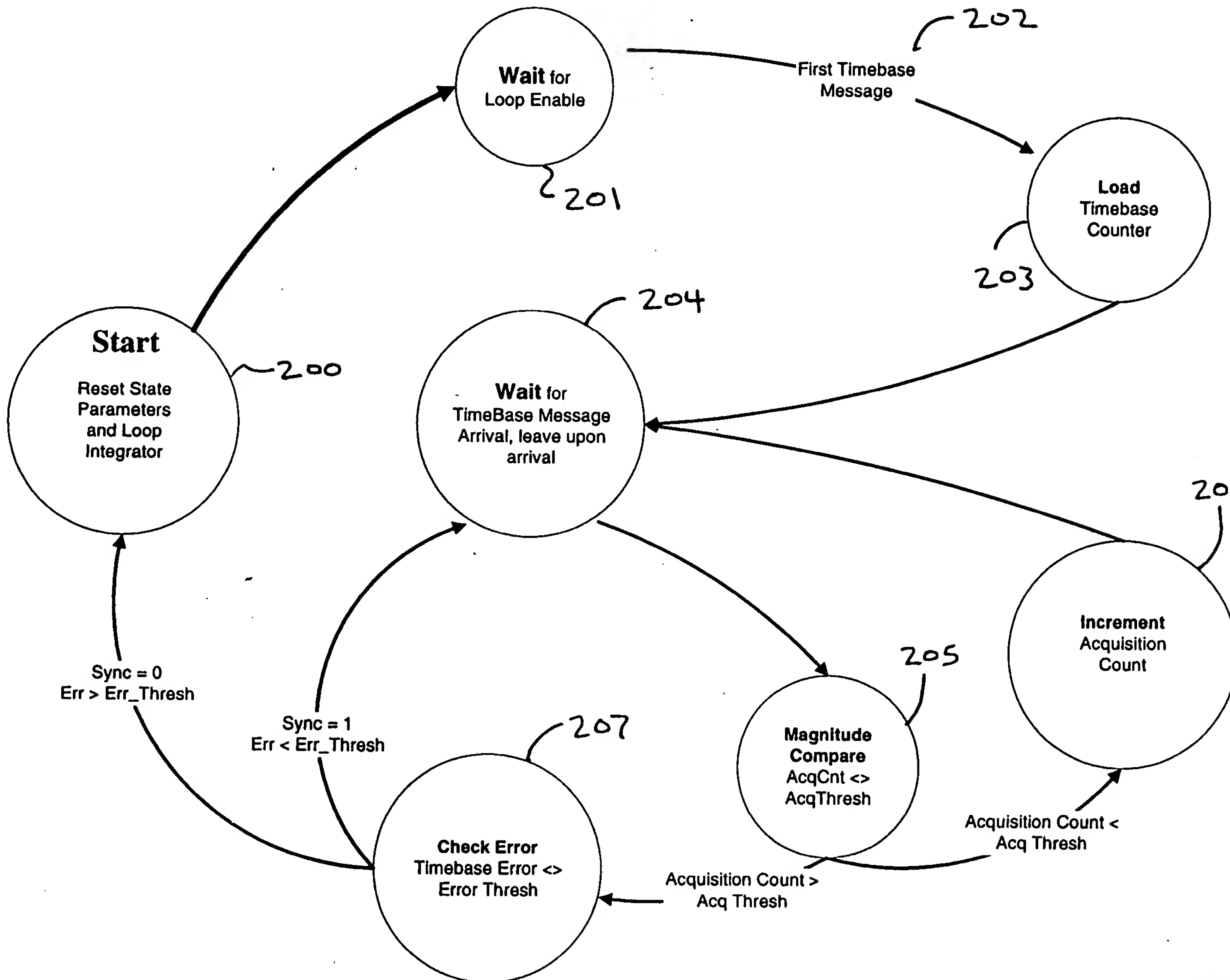


FIG. 7

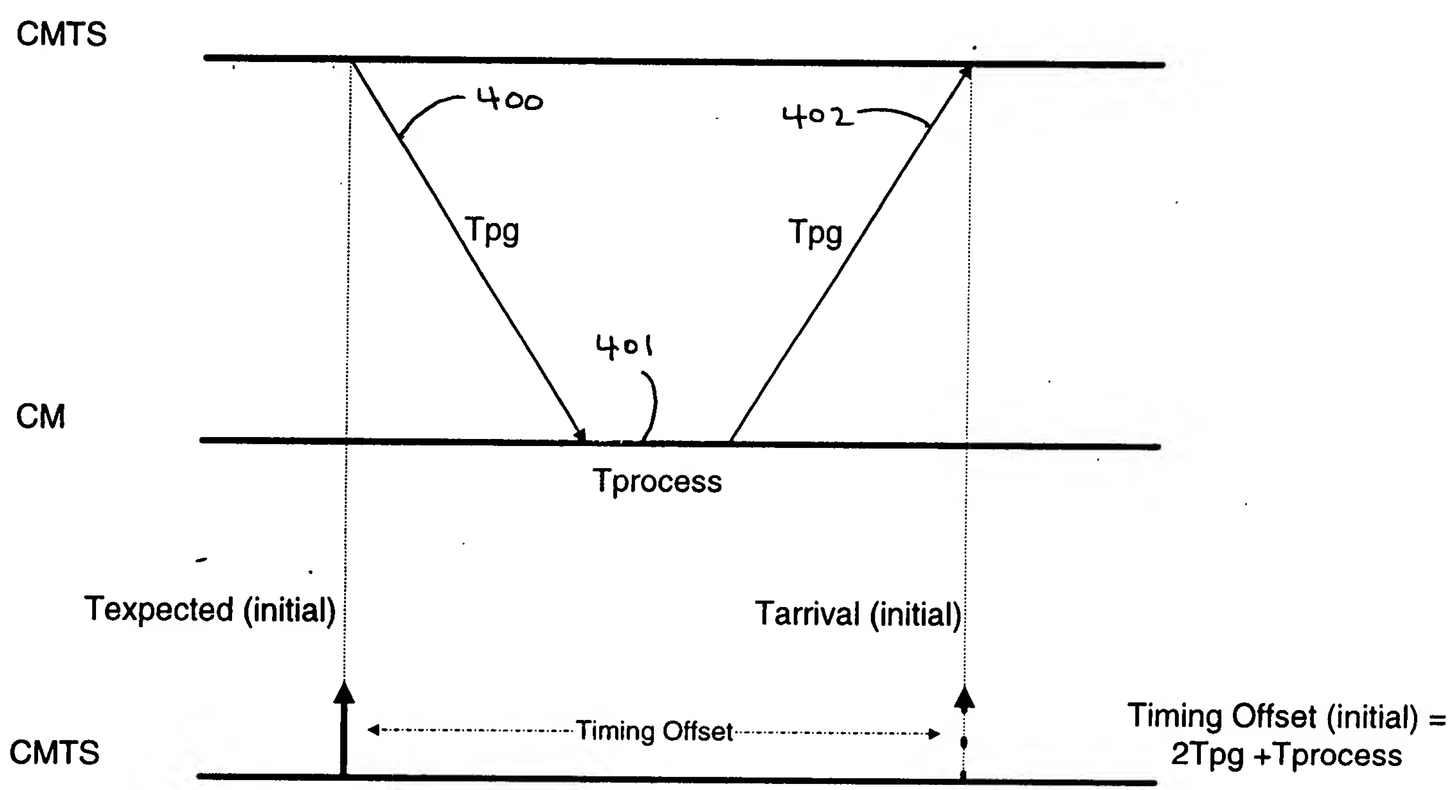
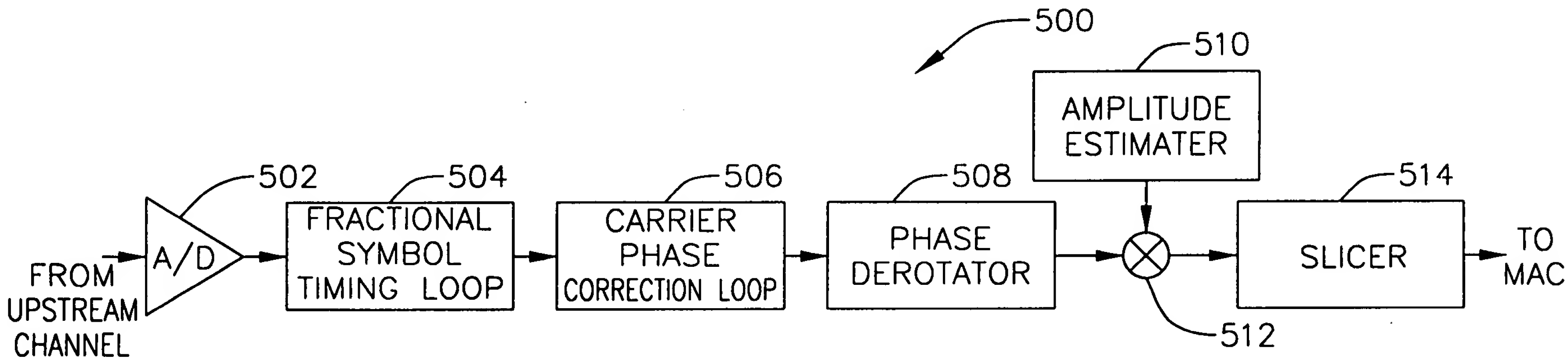


FIG. 8

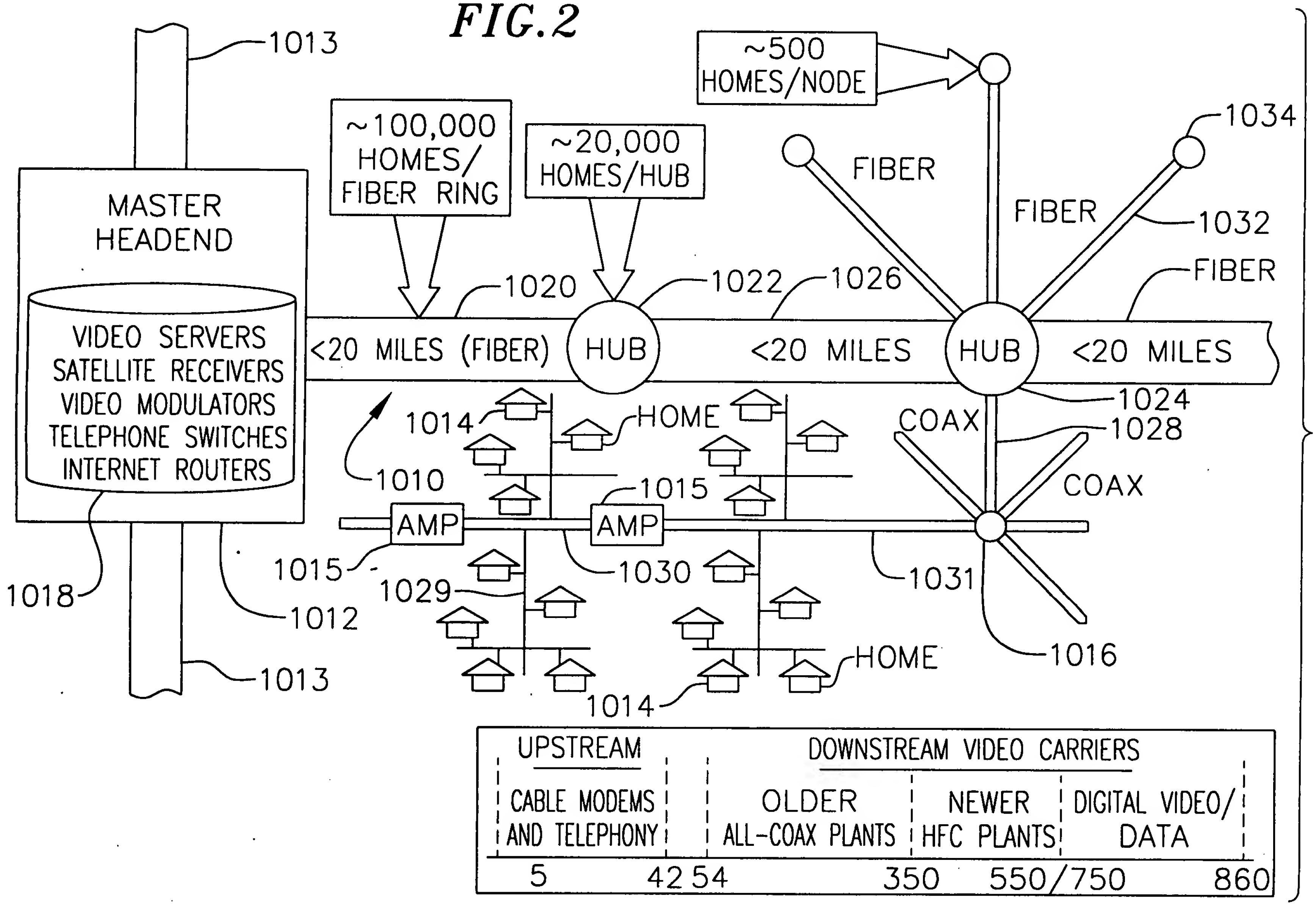
NETWORK DATA
TRANSMISSION
SYNCHRONIZATION SYSTEM
AND METHOD

FIG. 1



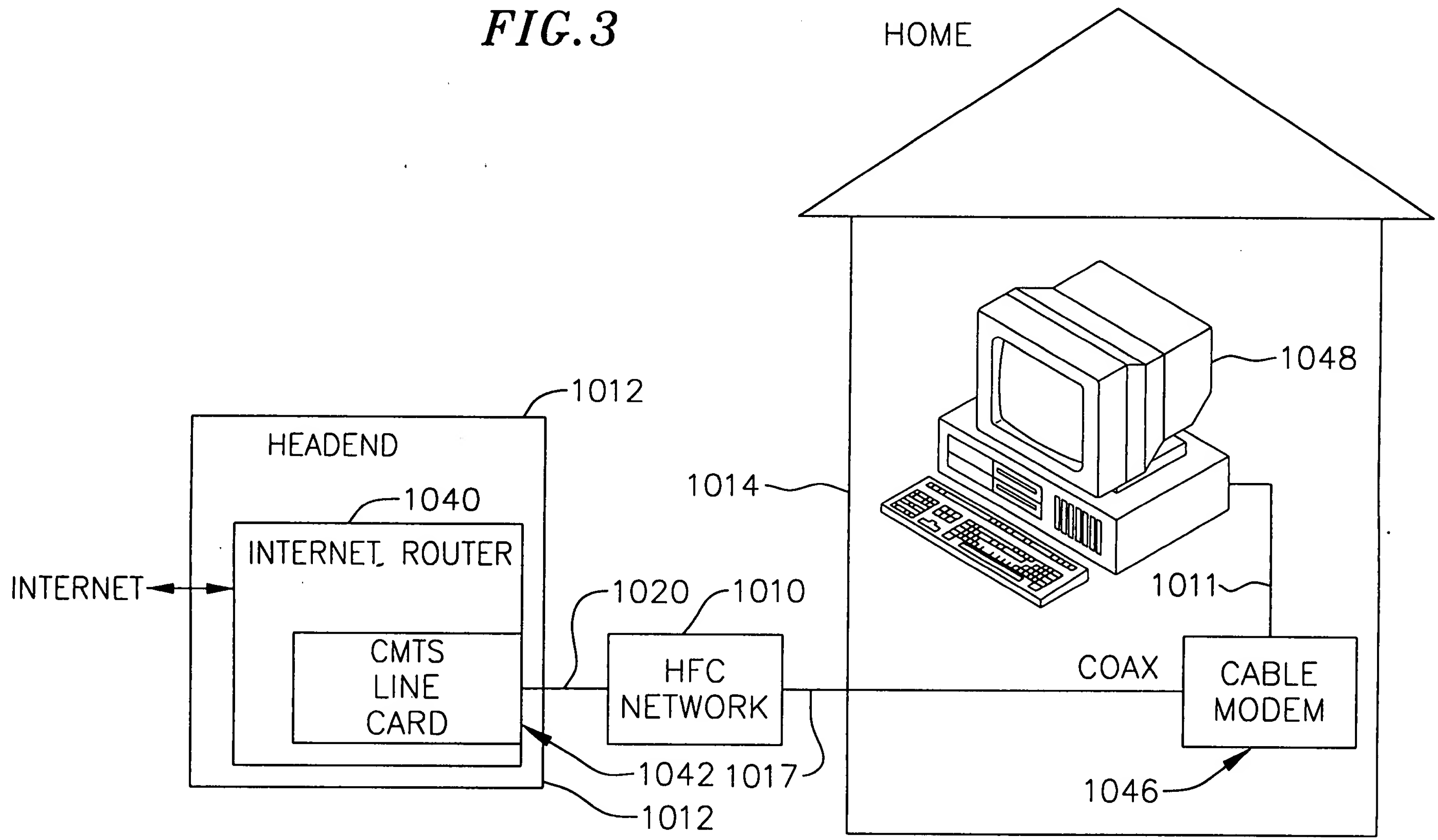
BURST RECEIVER FOR
CABLE MODEM SYSTEM

FIG.2



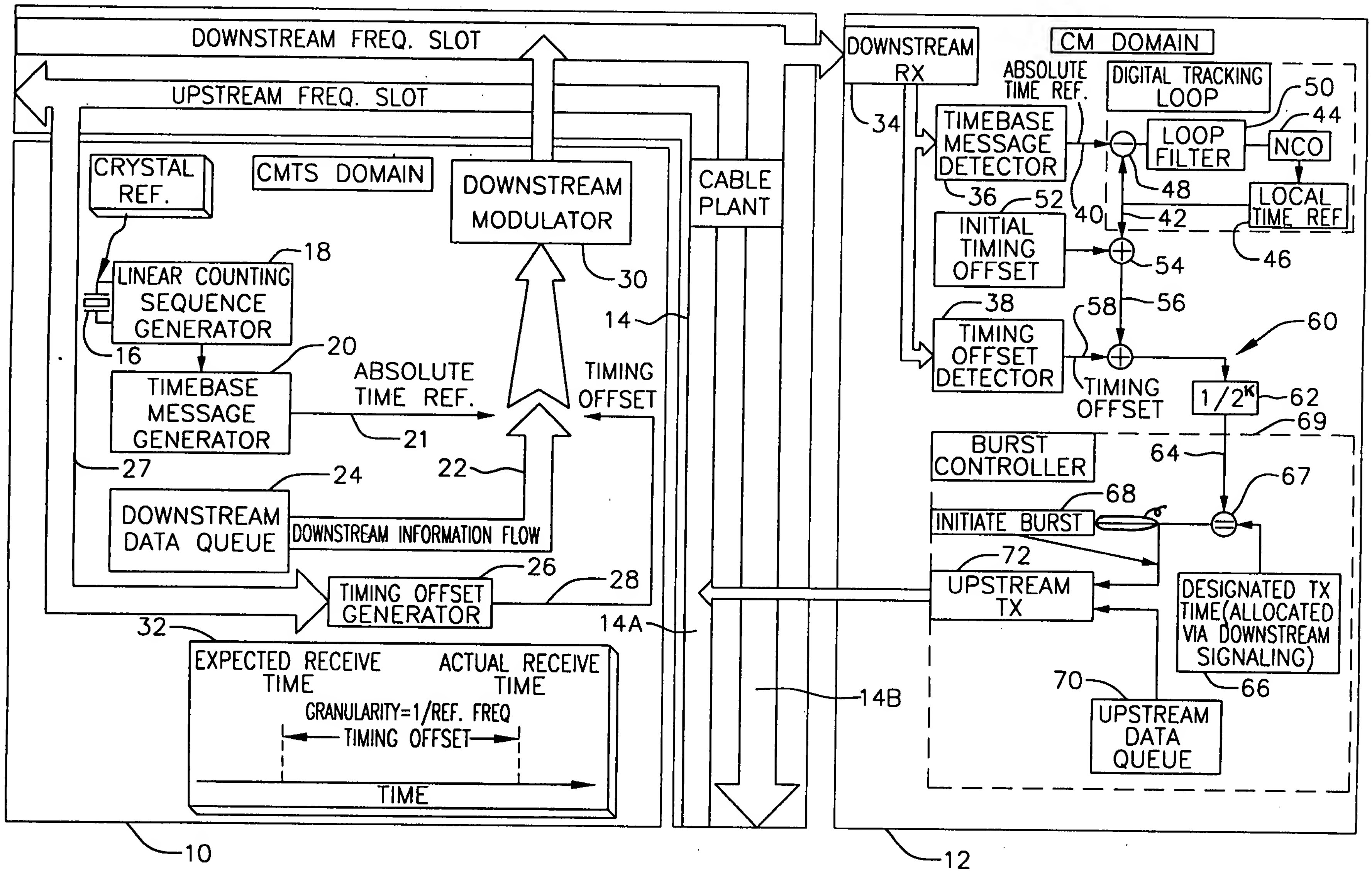
BURST RECEIVER FOR
CABLE MODEM SYSTEM

FIG.3



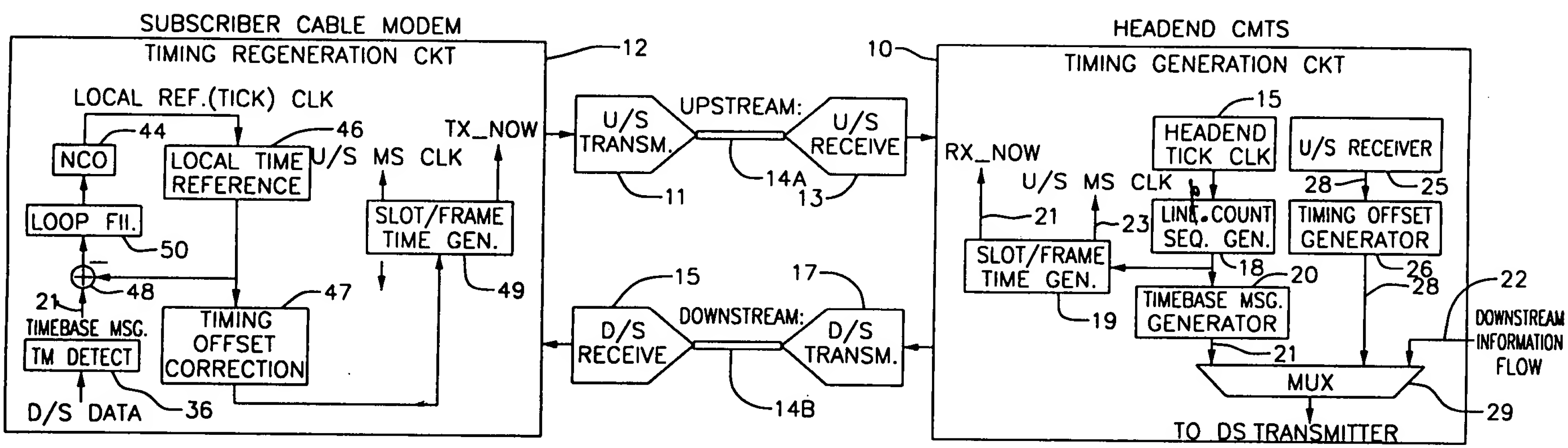
BURST RECEIVER FOR
CABLE MODEM SYSTEM

FIG.4



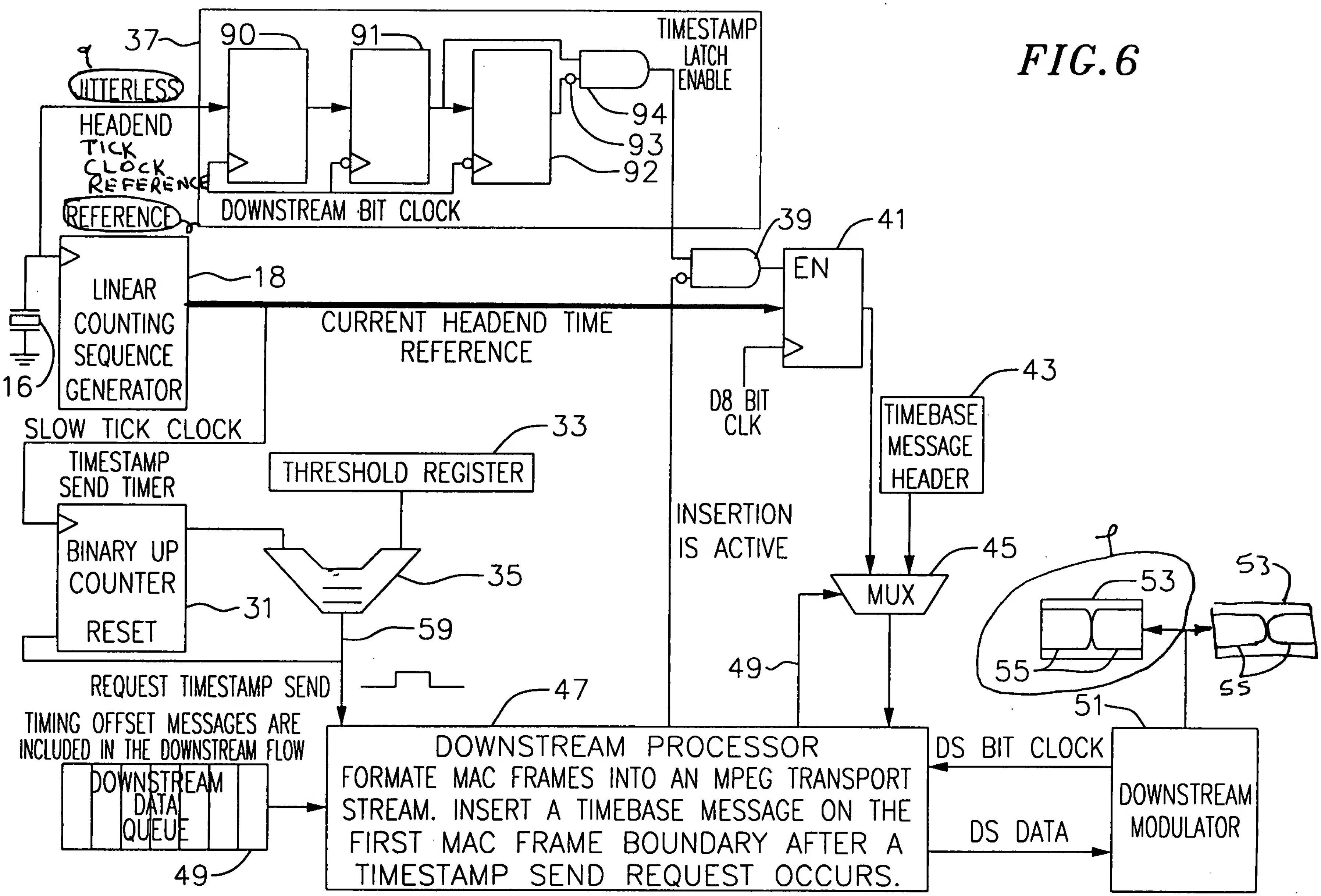
BURST RECEIVER FOR
CABLE MODEM SYSTEM

FIG.5



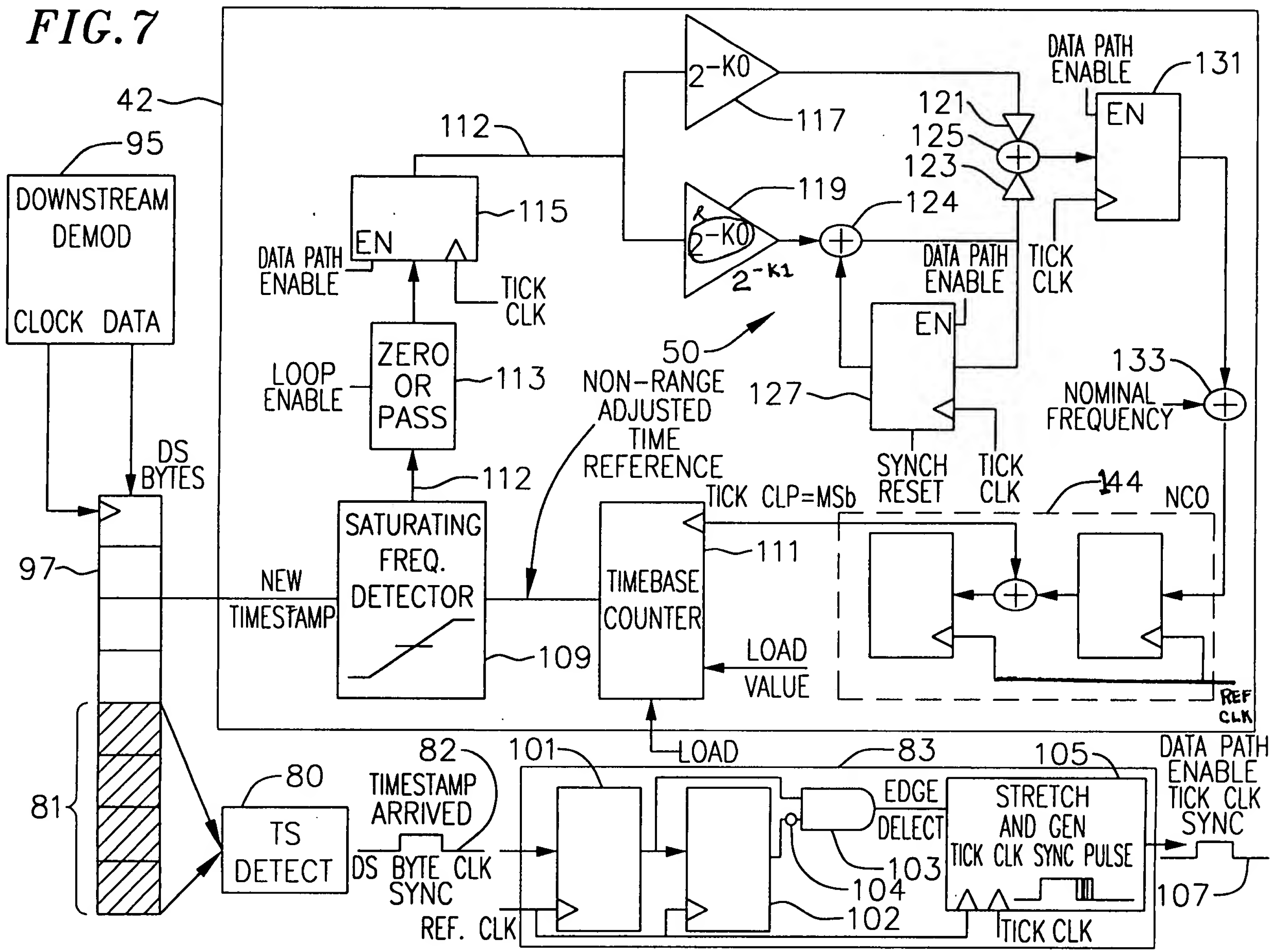
BURST RECEIVER FOR
CABLE MODEM SYSTEM

FIG. 6



BURST RECEIVER FOR
CABLE MODEM SYSTEM

FIG. 7



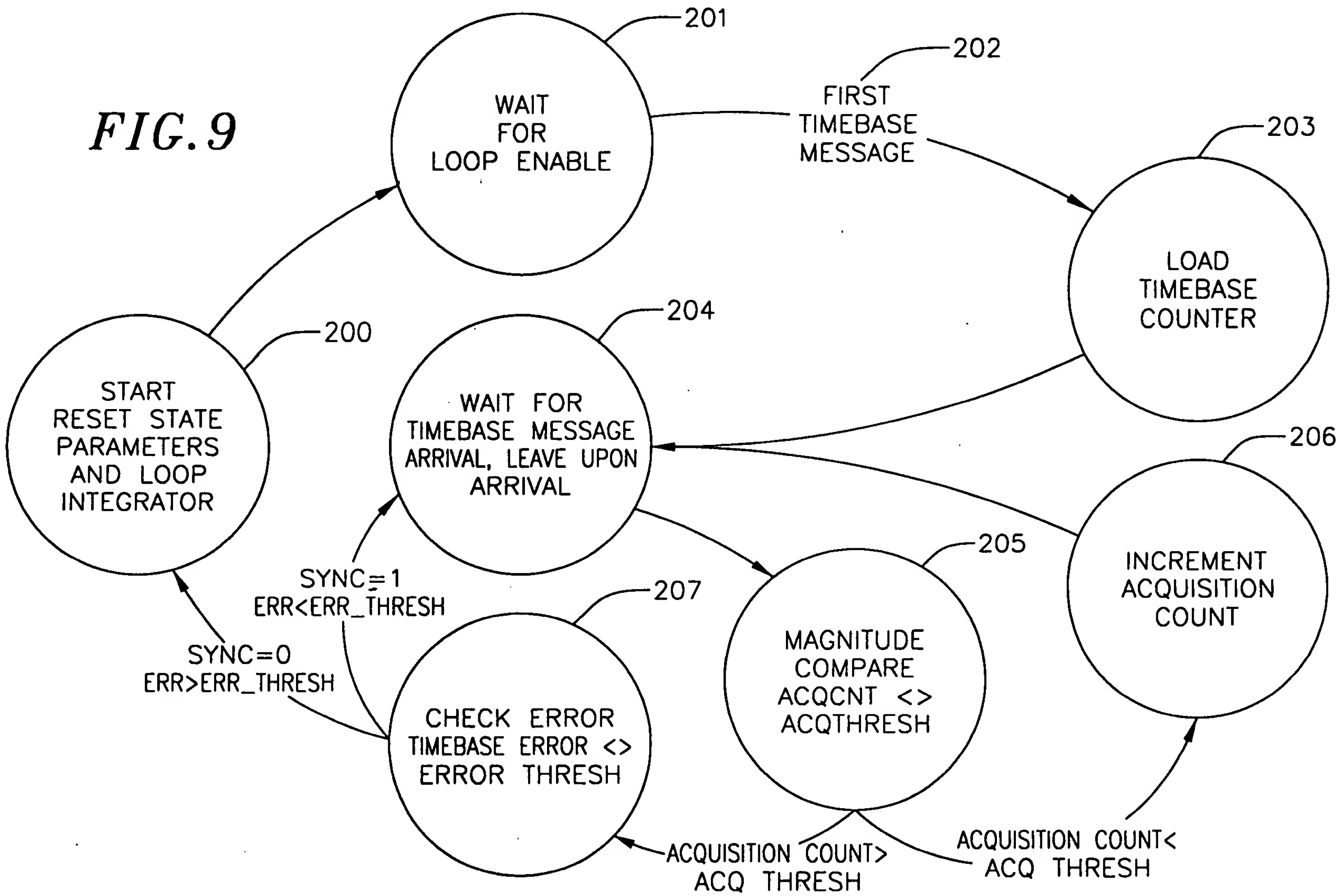
BURST RECEIVER FOR
CABLE MODEM SYSTEM

FIG.8

UPDATE RATE	COARSE COEFFS	FINE COEFFICIENTS
1kHz(1ms)	$K0=2^{-11}$ $K1=2^{-15}$ (BW=50Hz)	$K0=2^{-16}$ $K1=2^{-25}$ (BW=1Hz)
300Hz(3.3ms)	$K0=2^{-12}$ $K1=2^{-15}$ (BW=20Hz)	$K0=2^{-16}$ $K1=2^{-23}$ (BW=1Hz)
100Hz(10ms)	$K0=2^{-13}$ $K1=2^{-16}$ (BW=10Hz)	$K0=2^{-16}$ $K1=2^{-22}$ (BW=1Hz)
50Hz(20ms)	$K0=2^{-14}$ $K1=2^{-17}$ (BW=5Hz)	$K0=2^{-16}$ $K1=2^{-21}$ (BW=1Hz)
30Hz(33ms)	$K0=2^{-15}$ $K1=2^{-18}$ (BW=3Hz)	$K0=2^{-17}$ $K1=2^{-21}$ (BW=1Hz)
10Hz(100ms)	$K0=2^{-17}$ $K1=2^{-20}$ (BW=1Hz)	$K0=2^{-17}$ $K1=2^{-20}$ (BW=1Hz)
5Hz(200ms)	$K0=2^{-18}$ $K1=2^{-20}$ (BW=1Hz)	$K0=2^{-18}$ $K1=2^{-20}$ (BW=1Hz)

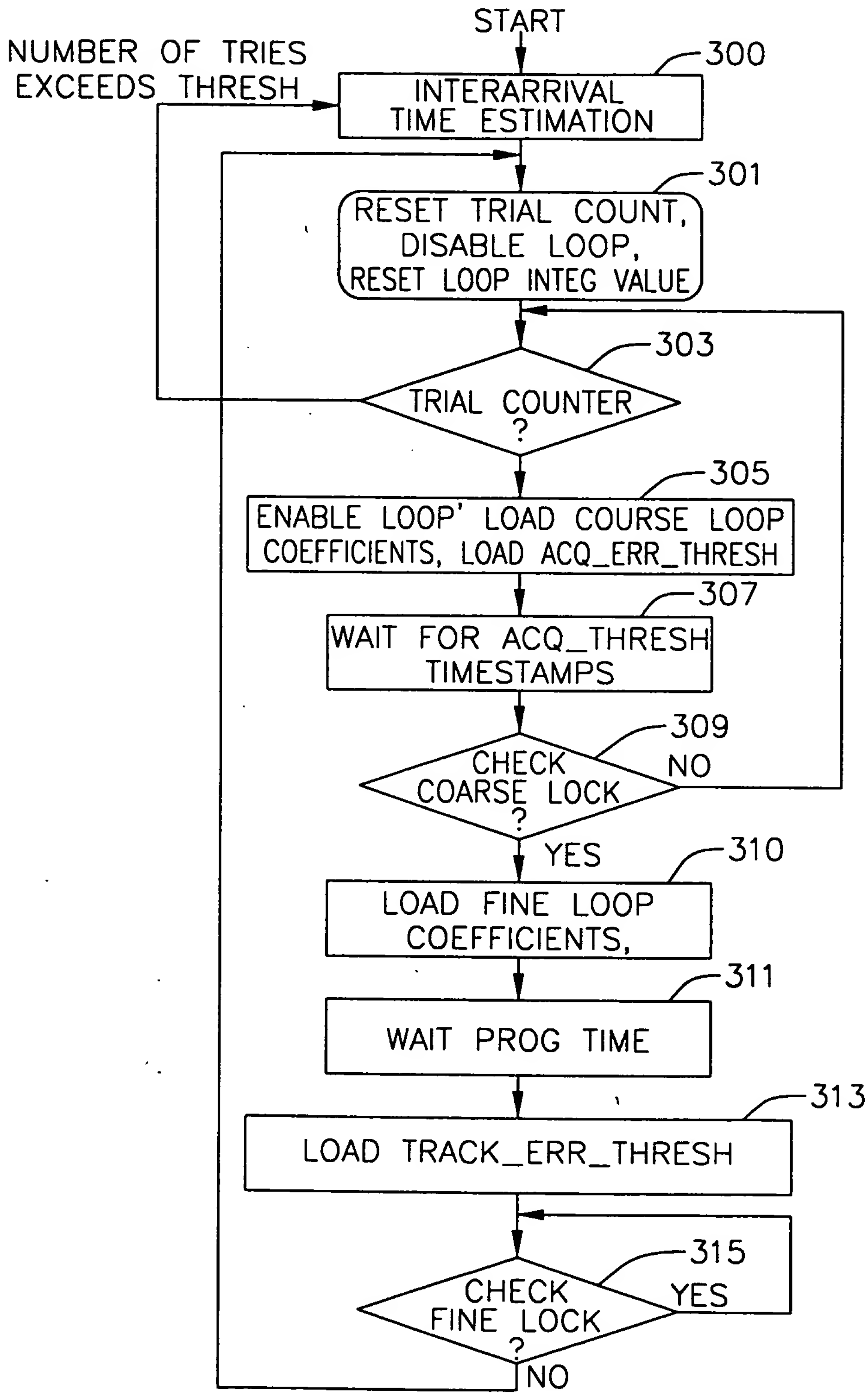
BURST RECEIVER FOR
CABLE MODEM SYSTEM

FIG.9



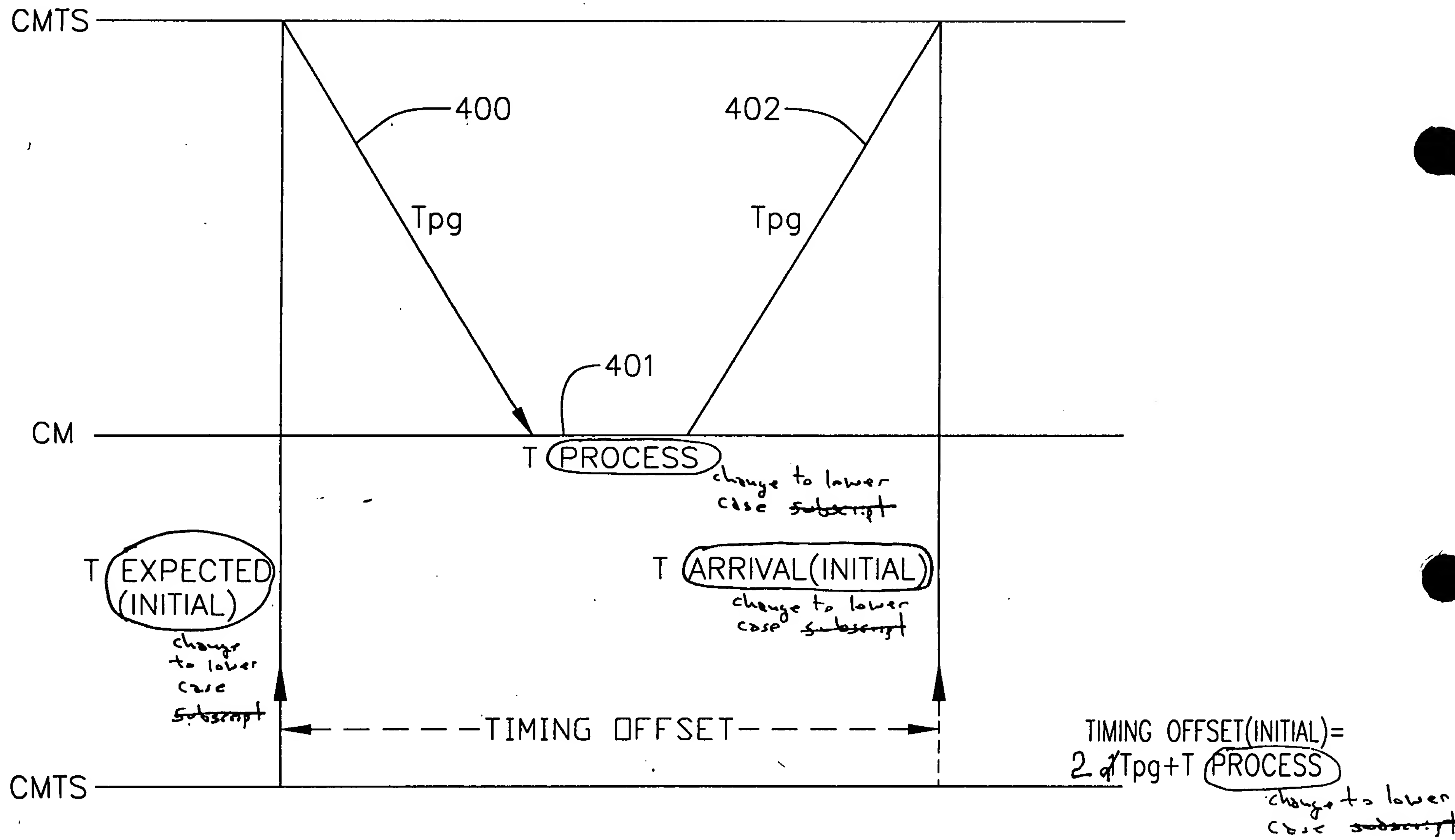
BURST RECEIVER FOR
CABLE MODEM SYSTEM

FIG. 10



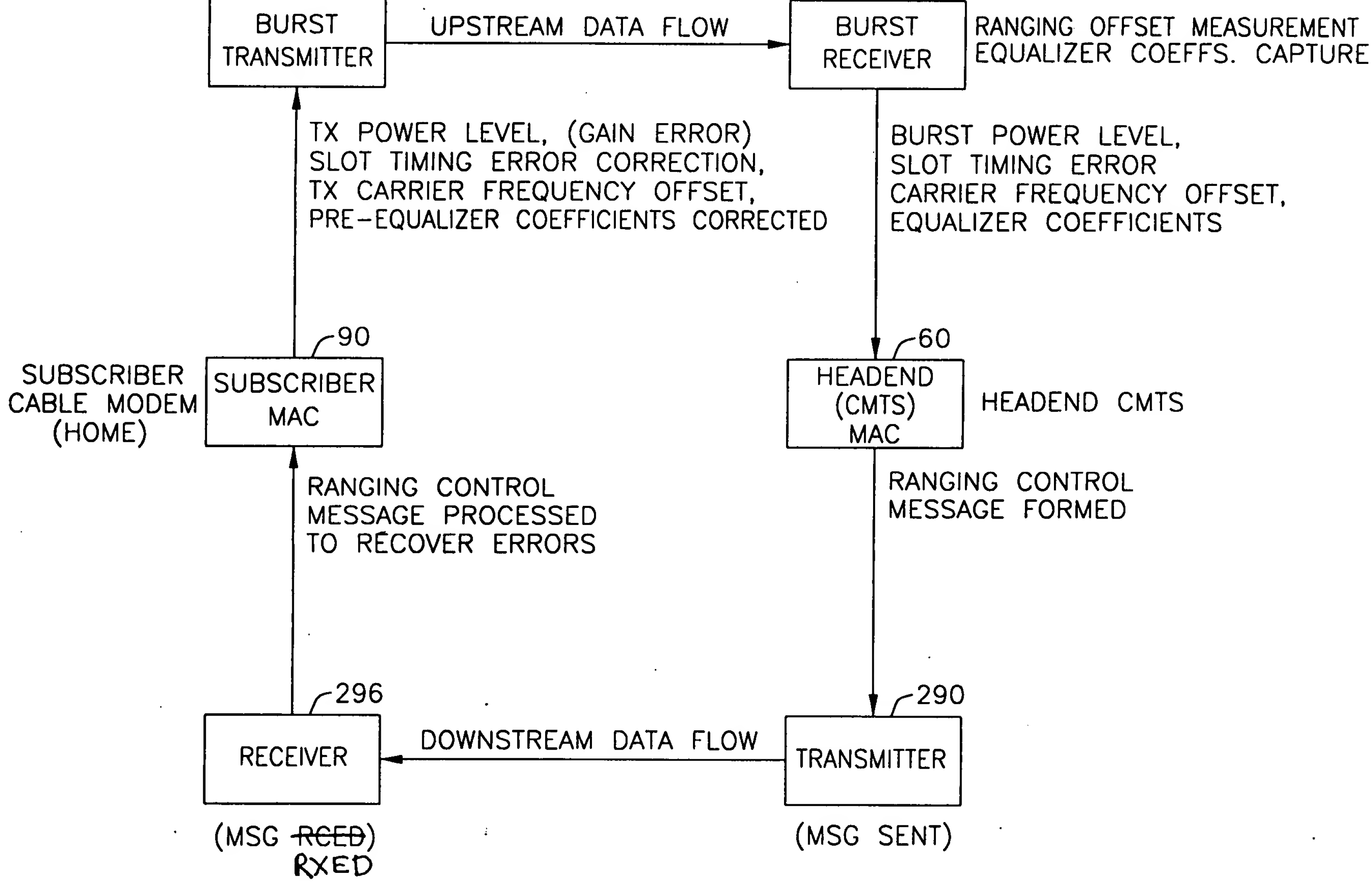
BURST RECEIVER FOR
CABLE MODEM SYSTEM

FIG. 11



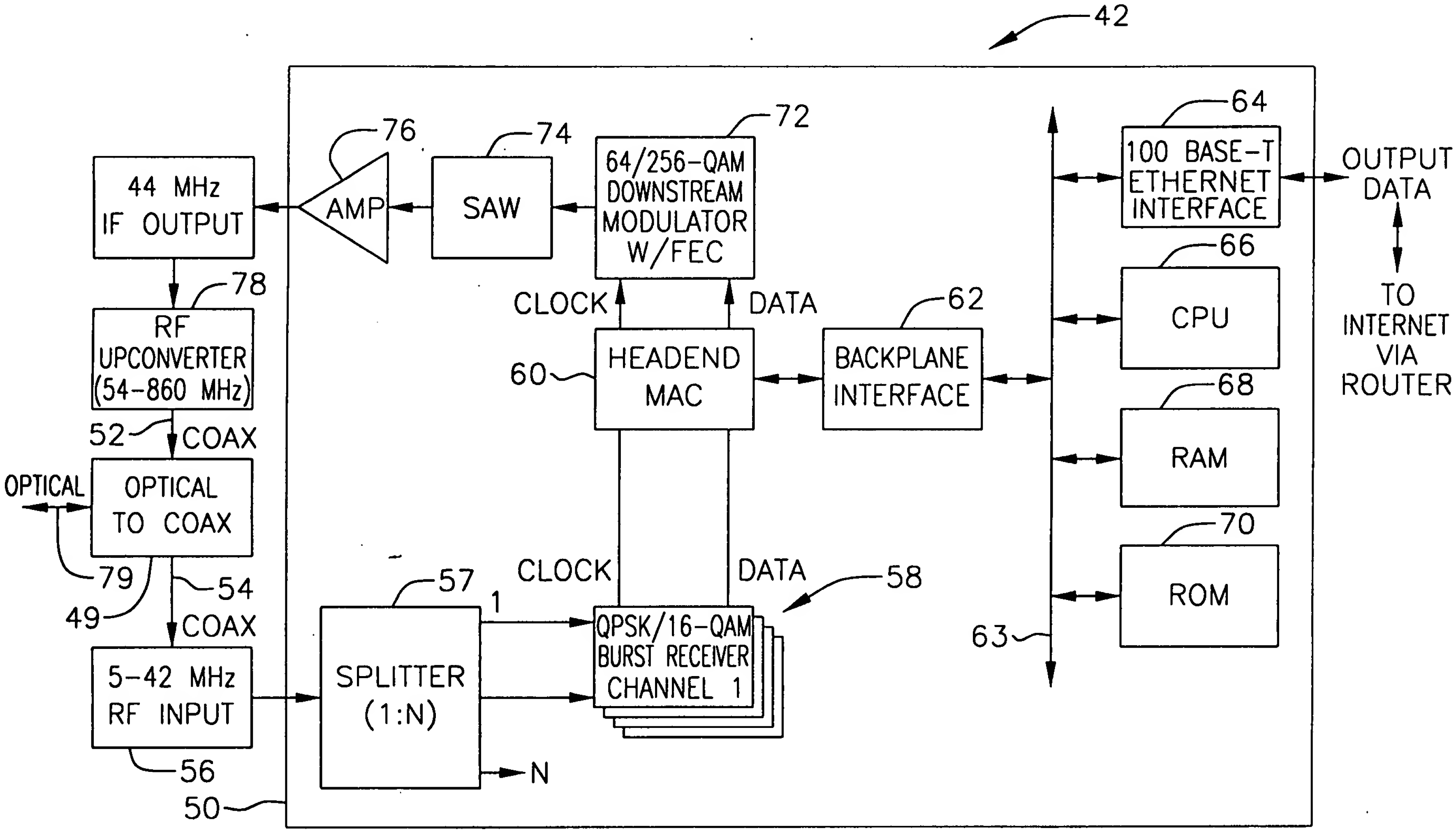
BURST RECEIVER FOR
CABLE MODEM SYSTEM

FIG. 12



BURST RECEIVER FOR
CABLE MODEM SYSTEM

FIG. 13



BURST RECEIVER FOR
CABLE MODEM SYSTEM

FIG. 14

PRIOR ART

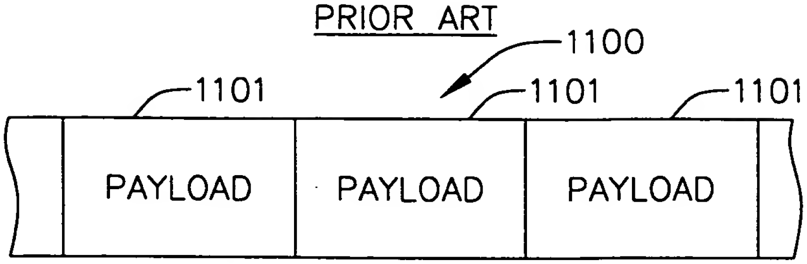


FIG. 15

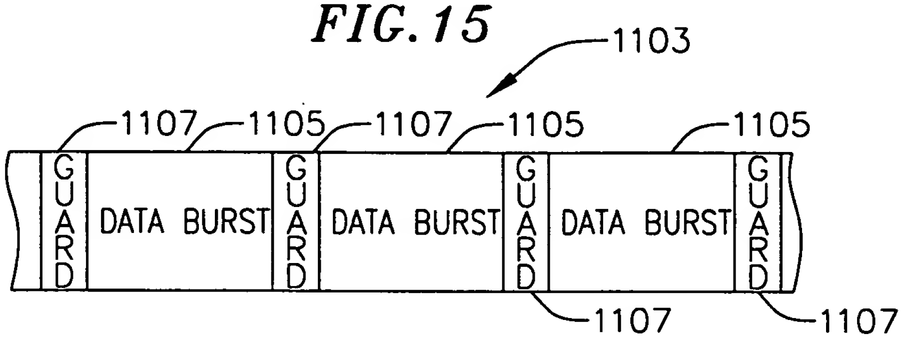


FIG. 16

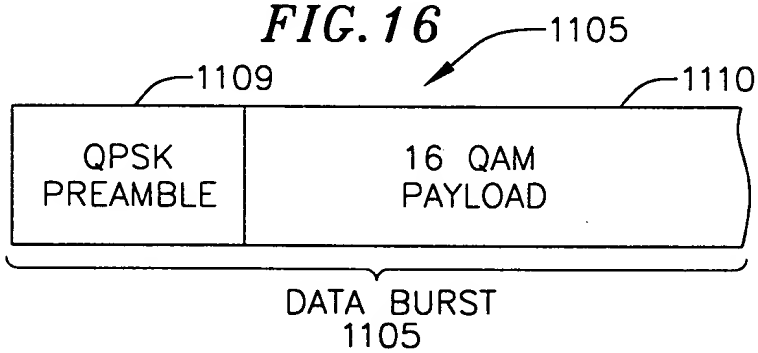
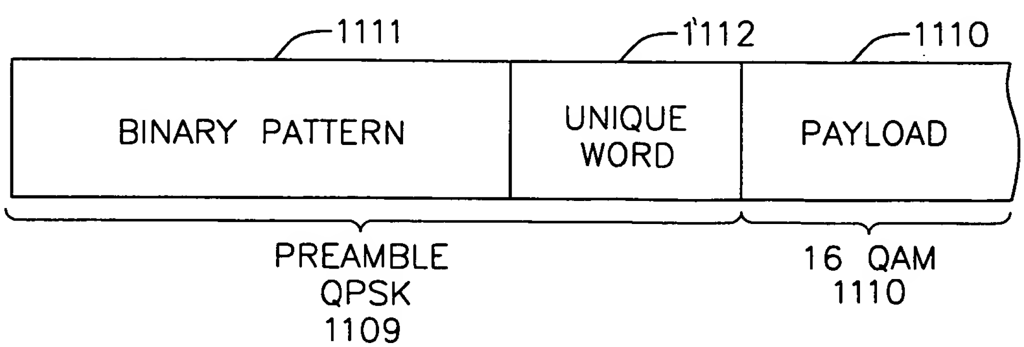


FIG. 17



BURST RECEIVER FOR
CABLE MODEM SYSTEM

FIG.18

PRIOR ART

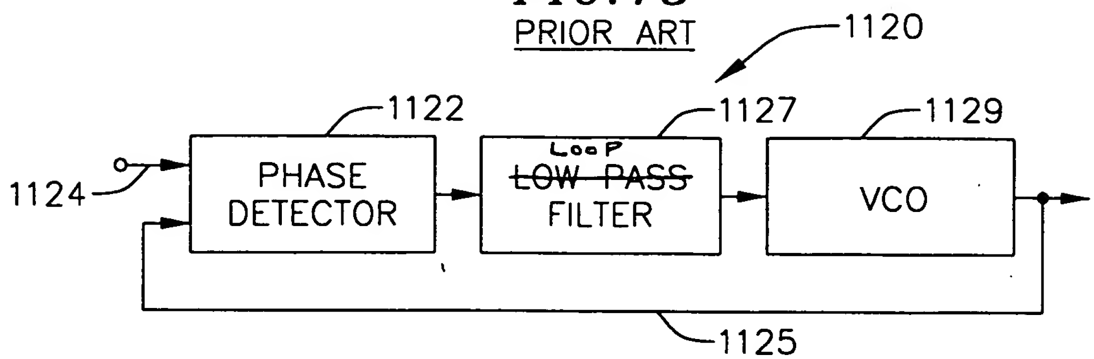


FIG.19

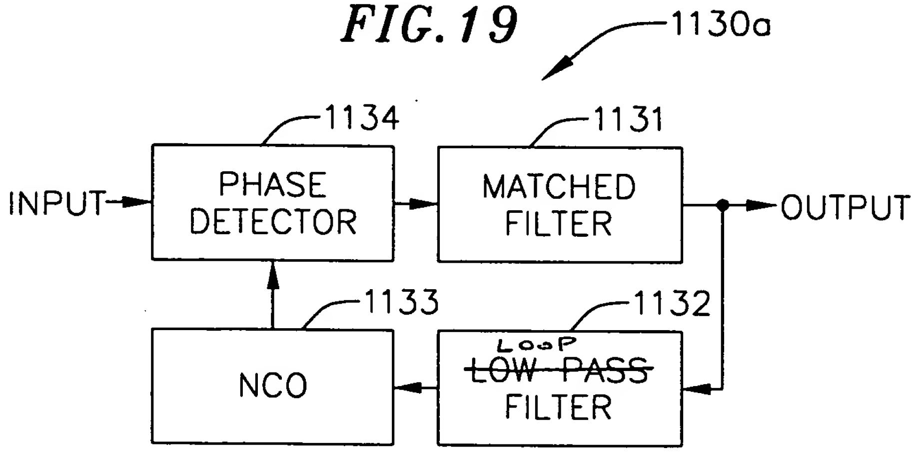
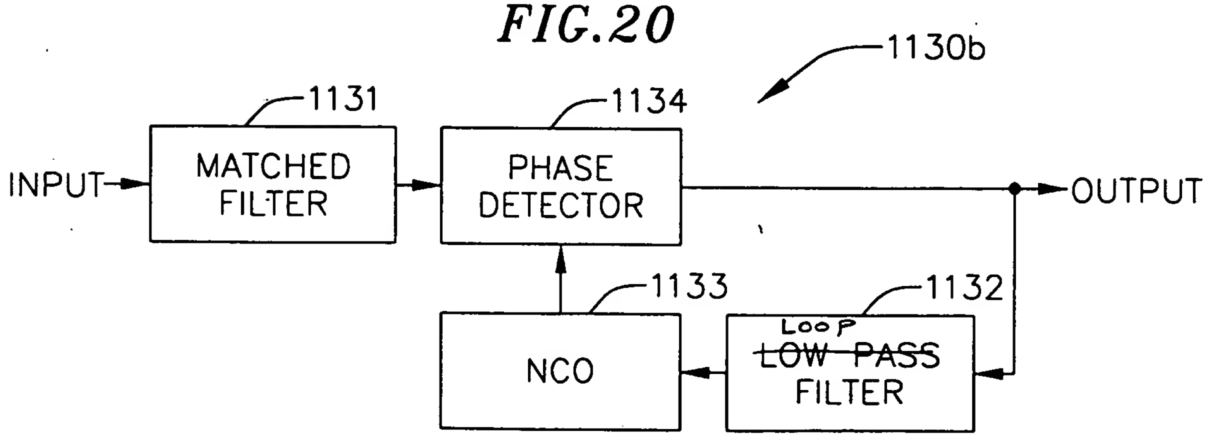
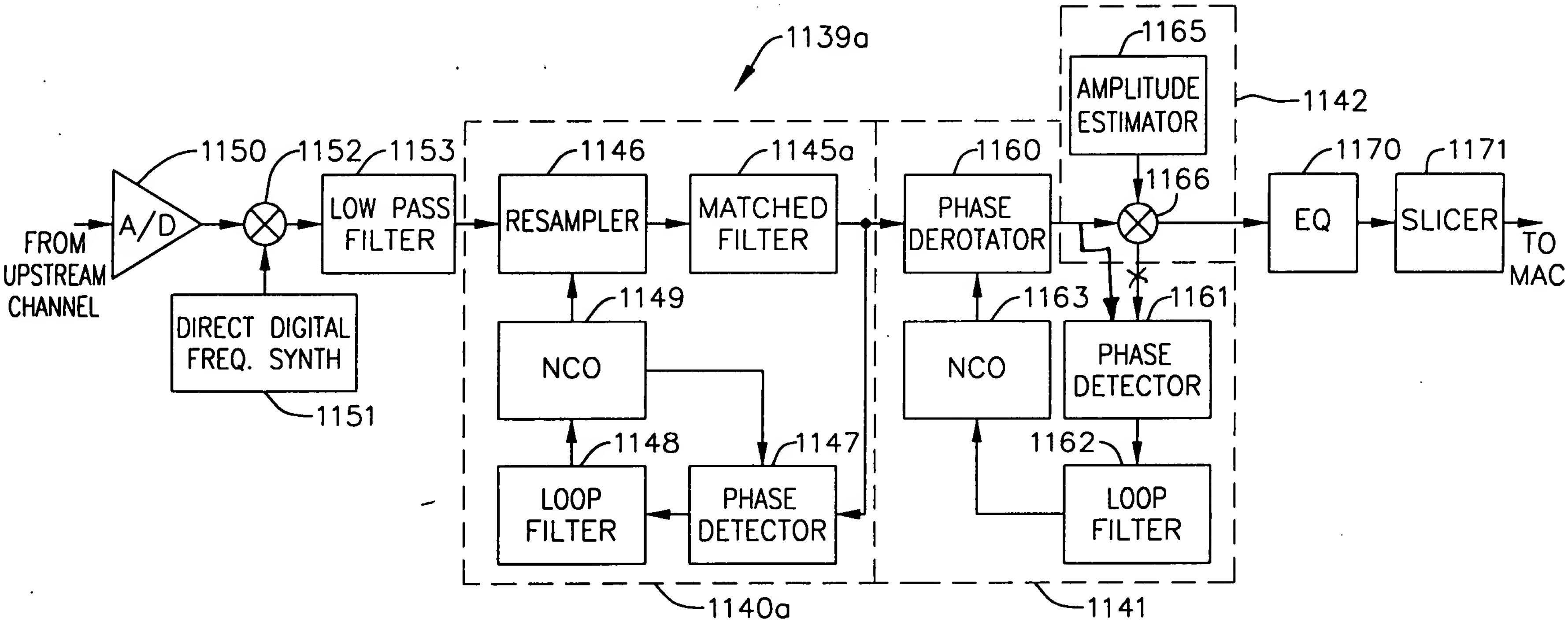


FIG.20



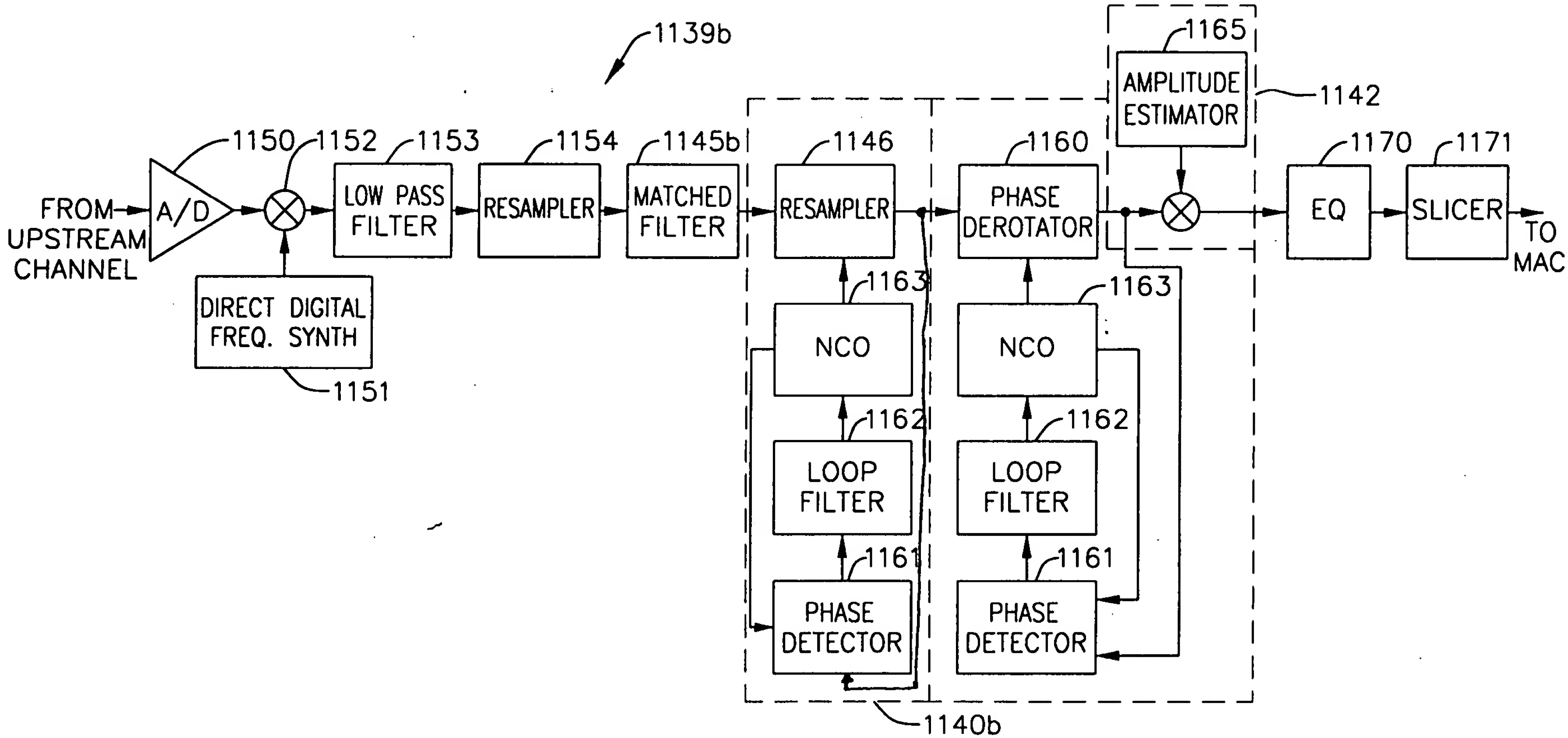
BURST RECEIVER FOR
CABLE MODEM SYSTEM

FIG.21



BURST RECEIVER FOR
CABLE MODEM SYSTEM

FIG.22



BURST RECEIVER FOR
CABLE MODEM SYSTEM

FIG.23

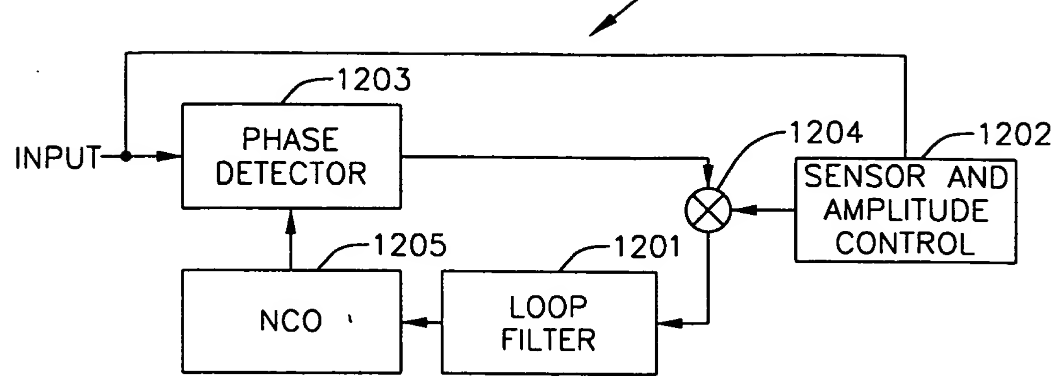


FIG.24

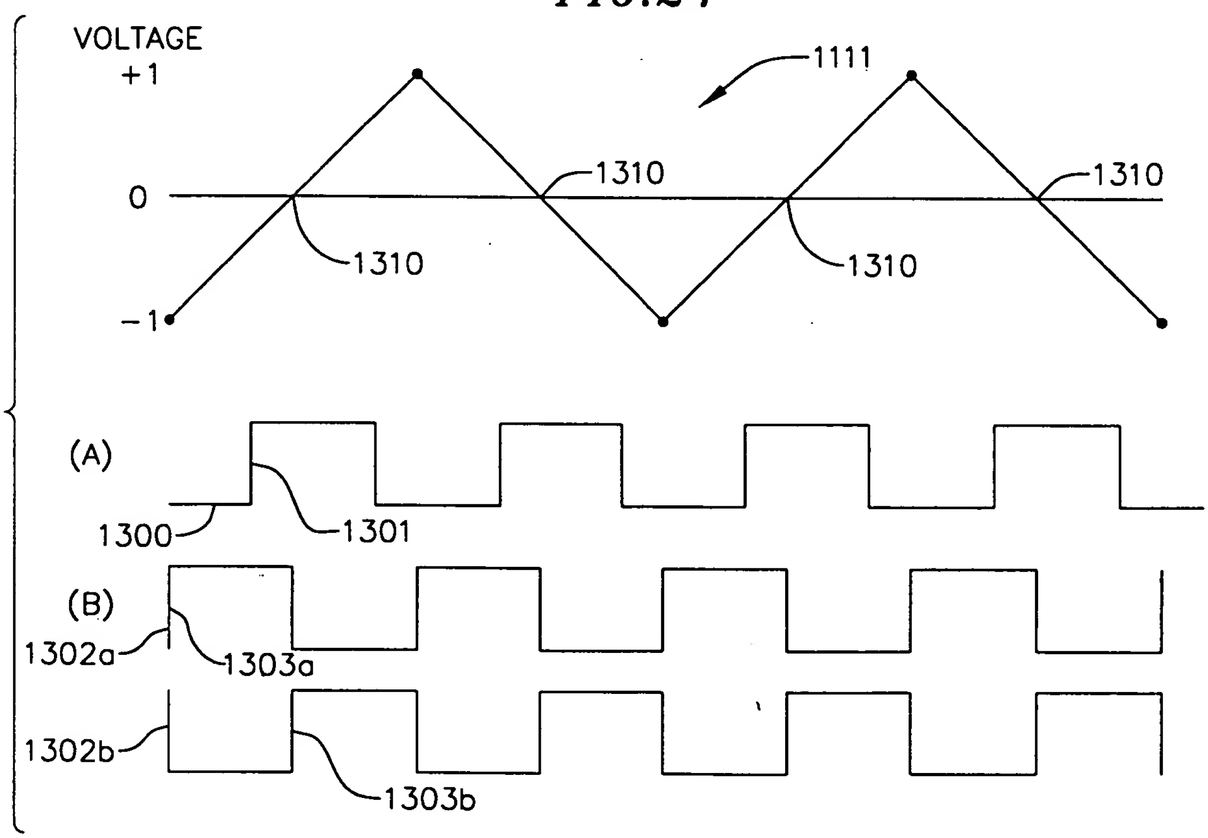


FIG.25

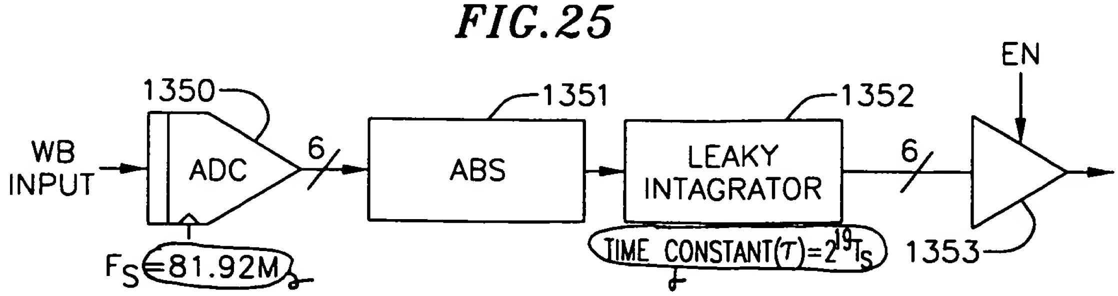
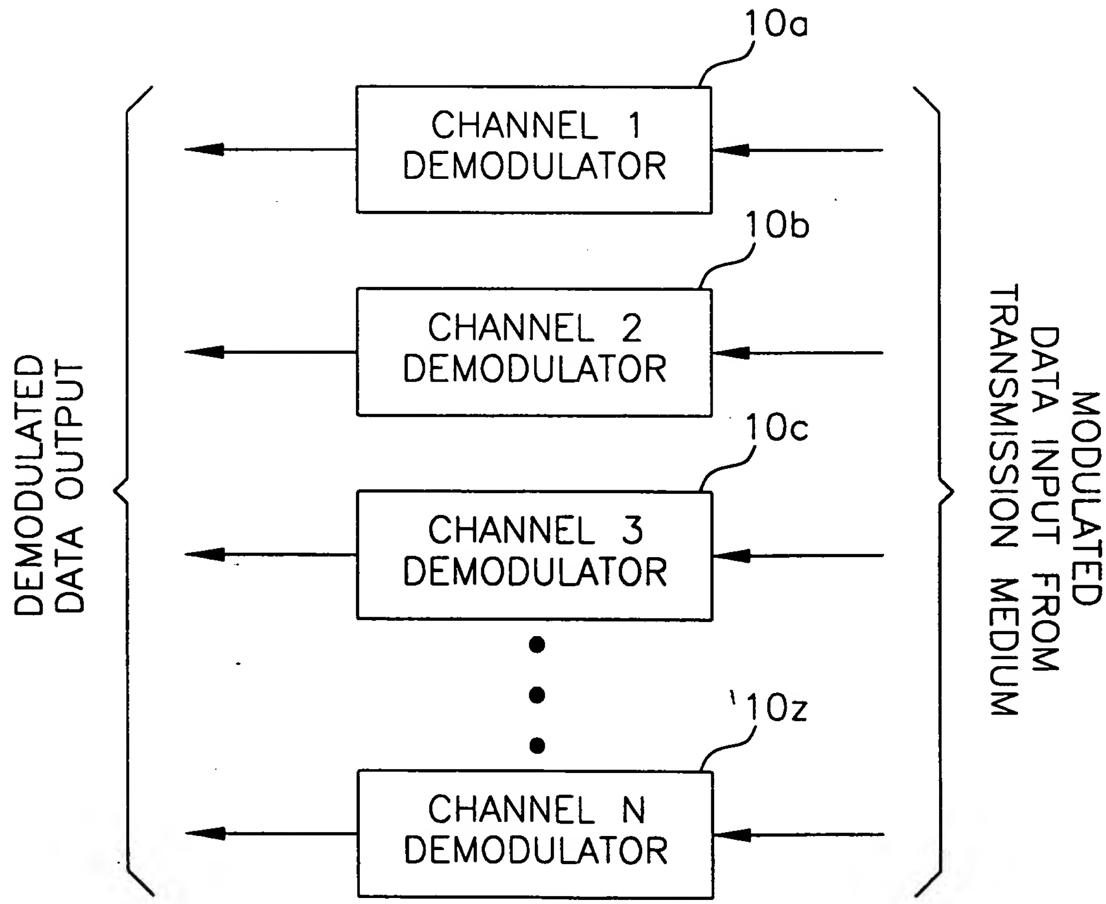


FIG. 1

PRIOR ART



ROBUST TECHNIQUES FOR
OPTIMAL UPSTREAM
COMMUNICATION

ROBUST TECHNIQUES FOR
OPTIMAL UPSTREAM
COMMUNICATION

FIG.2

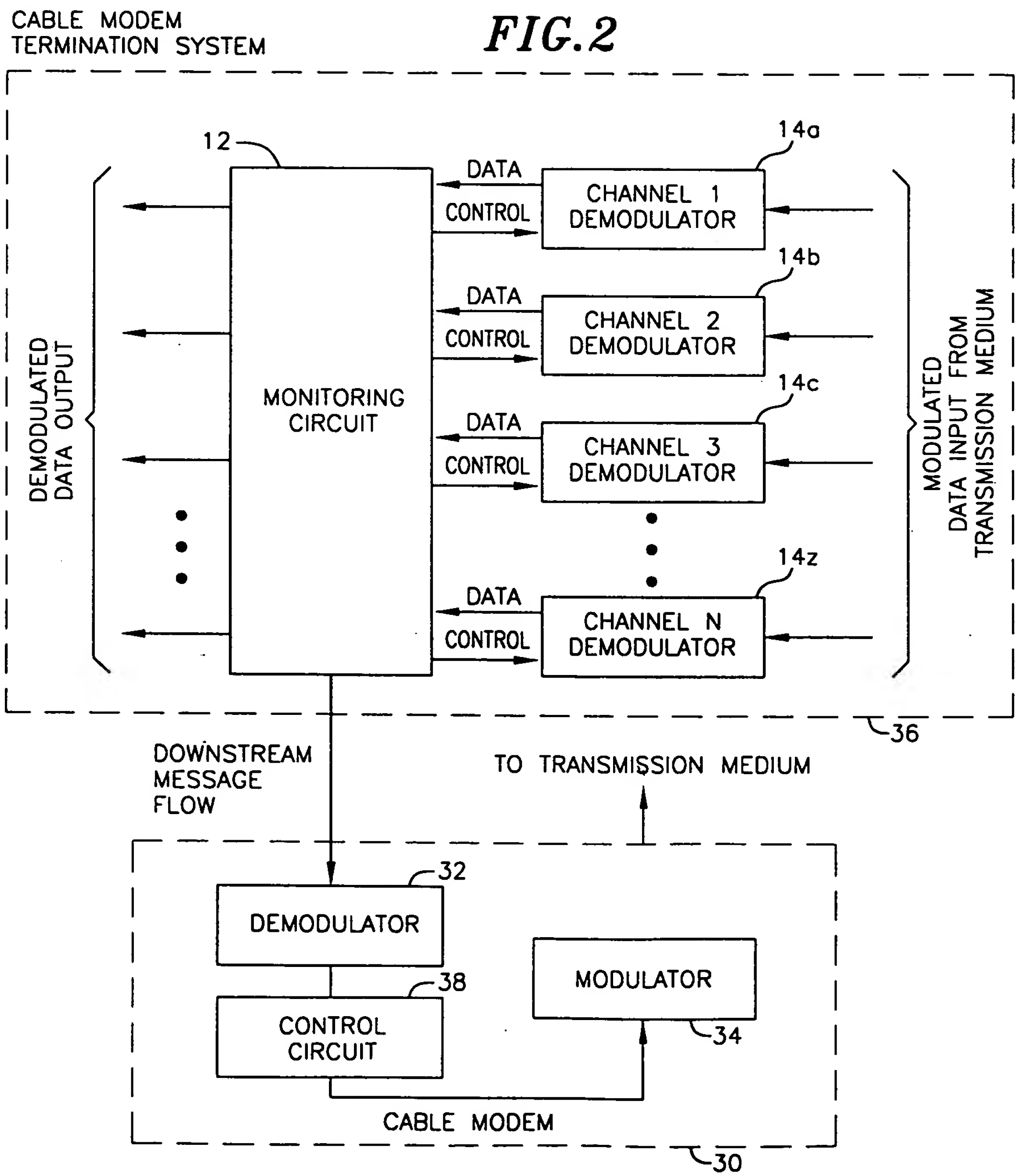
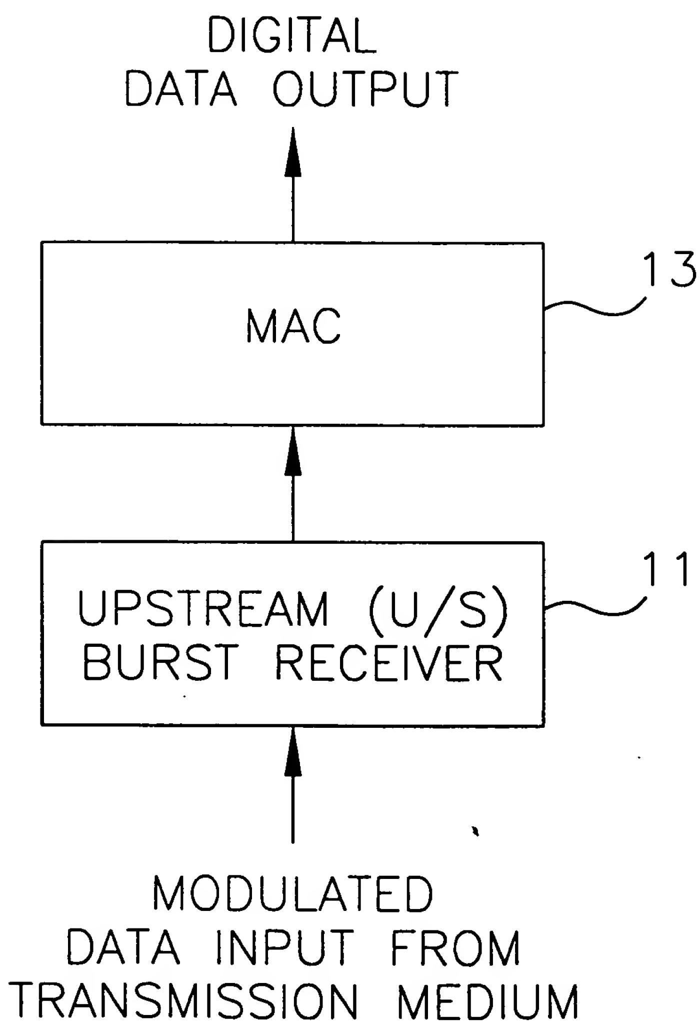
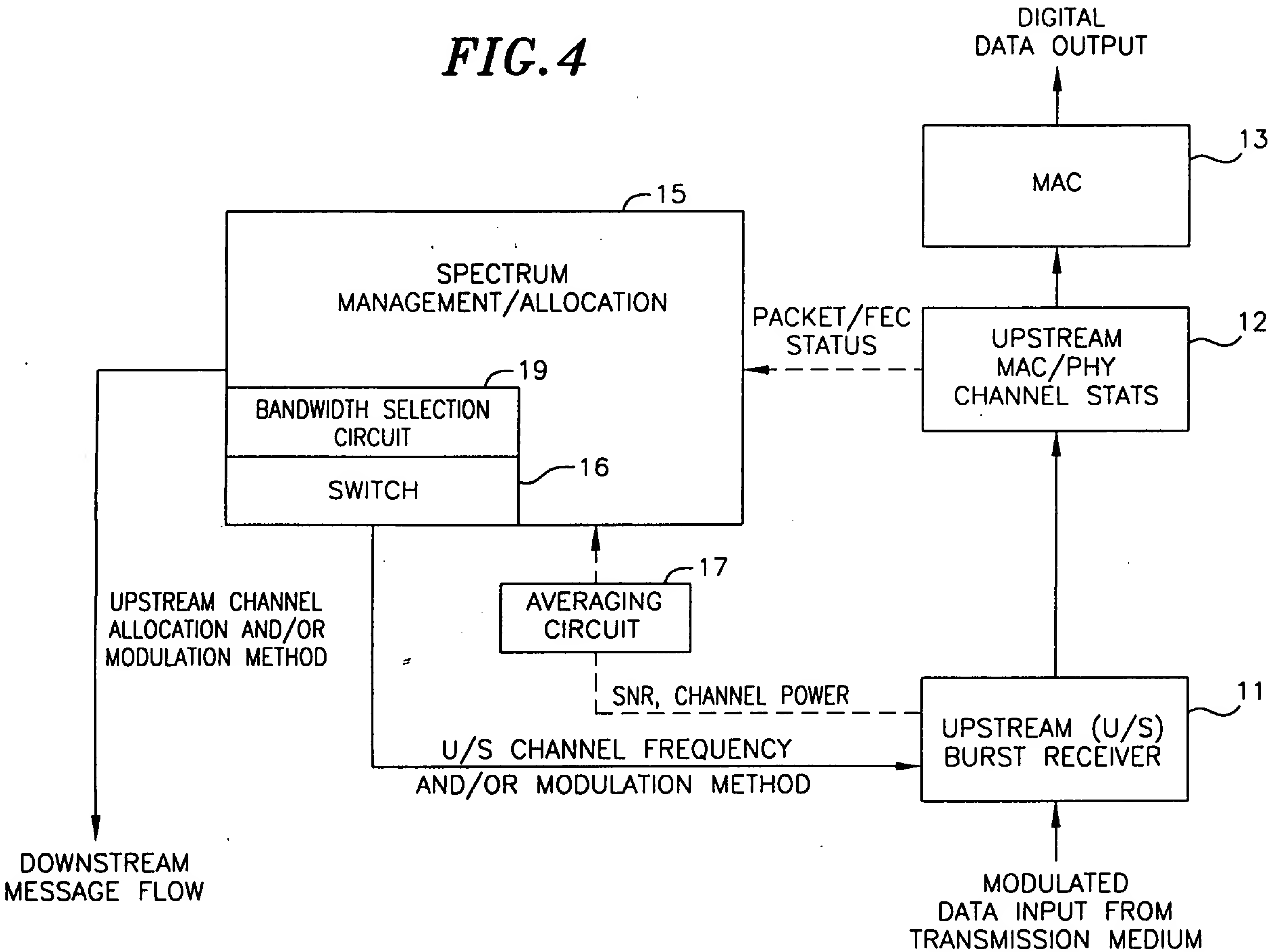


FIG.3
PRIOR ART



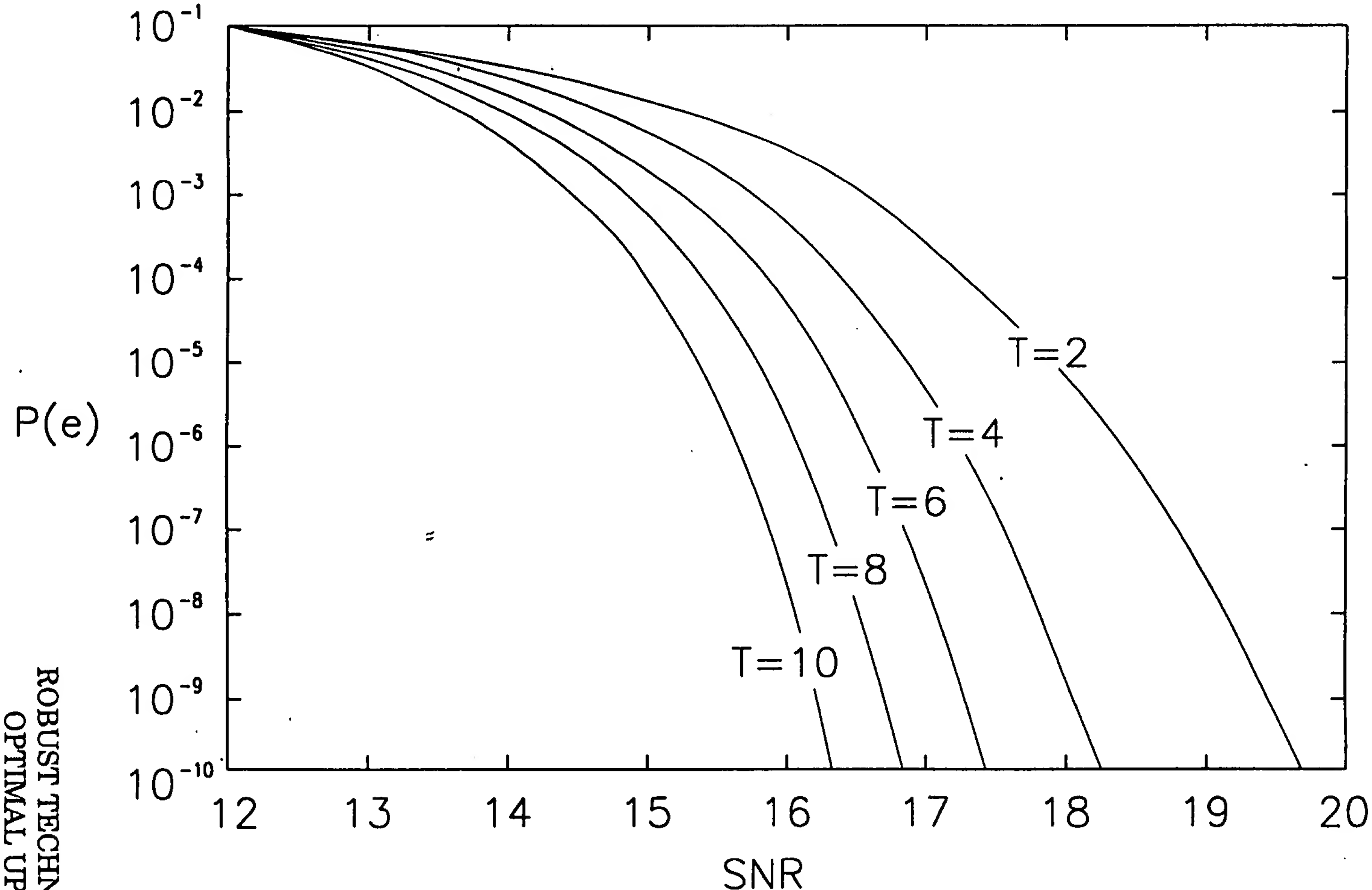
ROBUST TECHNIQUES FOR
OPTIMAL UPSTREAM
COMMUNICATION

FIG. 4



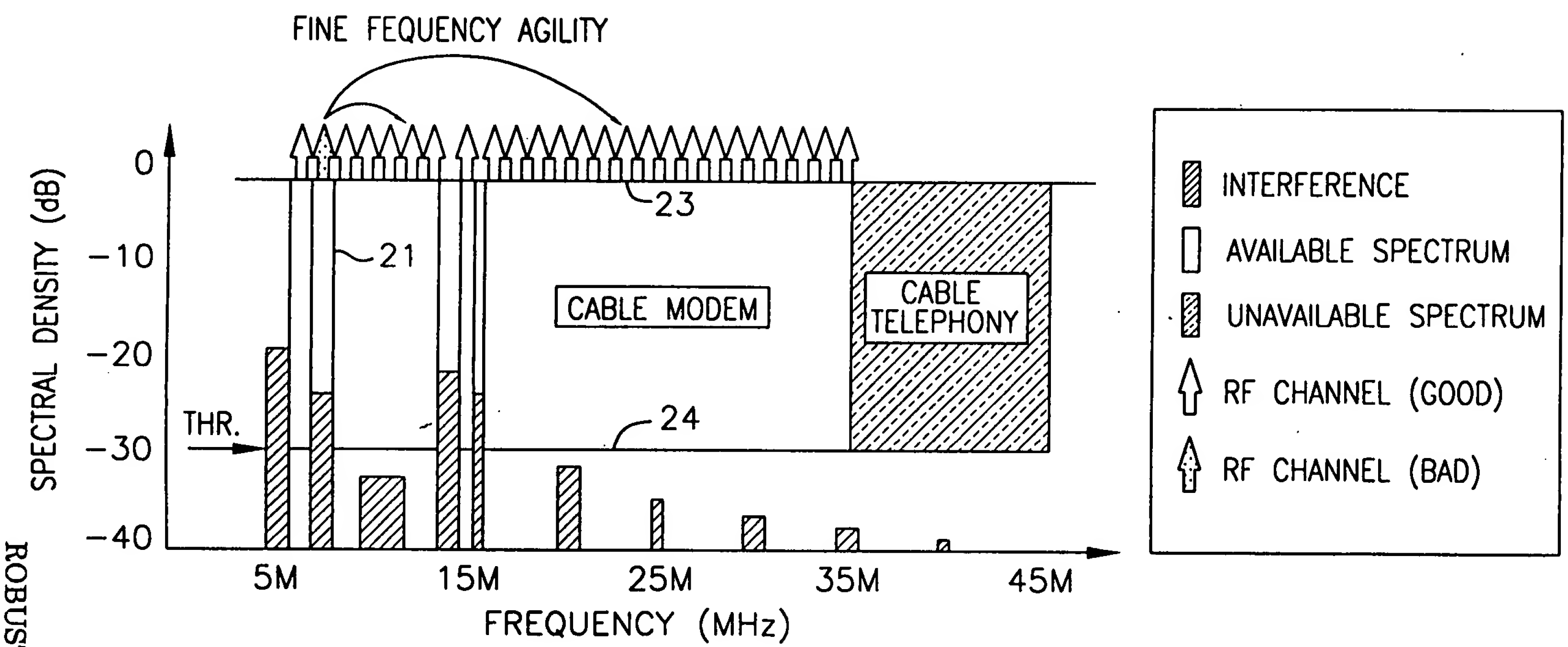
ROBUST TECHNIQUES FOR
OPTIMAL UPSTREAM
COMMUNICATION

FIG.5



ROBUST TECHNIQUES FOR
OPTIMAL UPSTREAM
COMMUNICATION

FIG. 6



ROBUST TECHNIQUES FOR OPTIMAL UPSTREAM COMMUNICATION

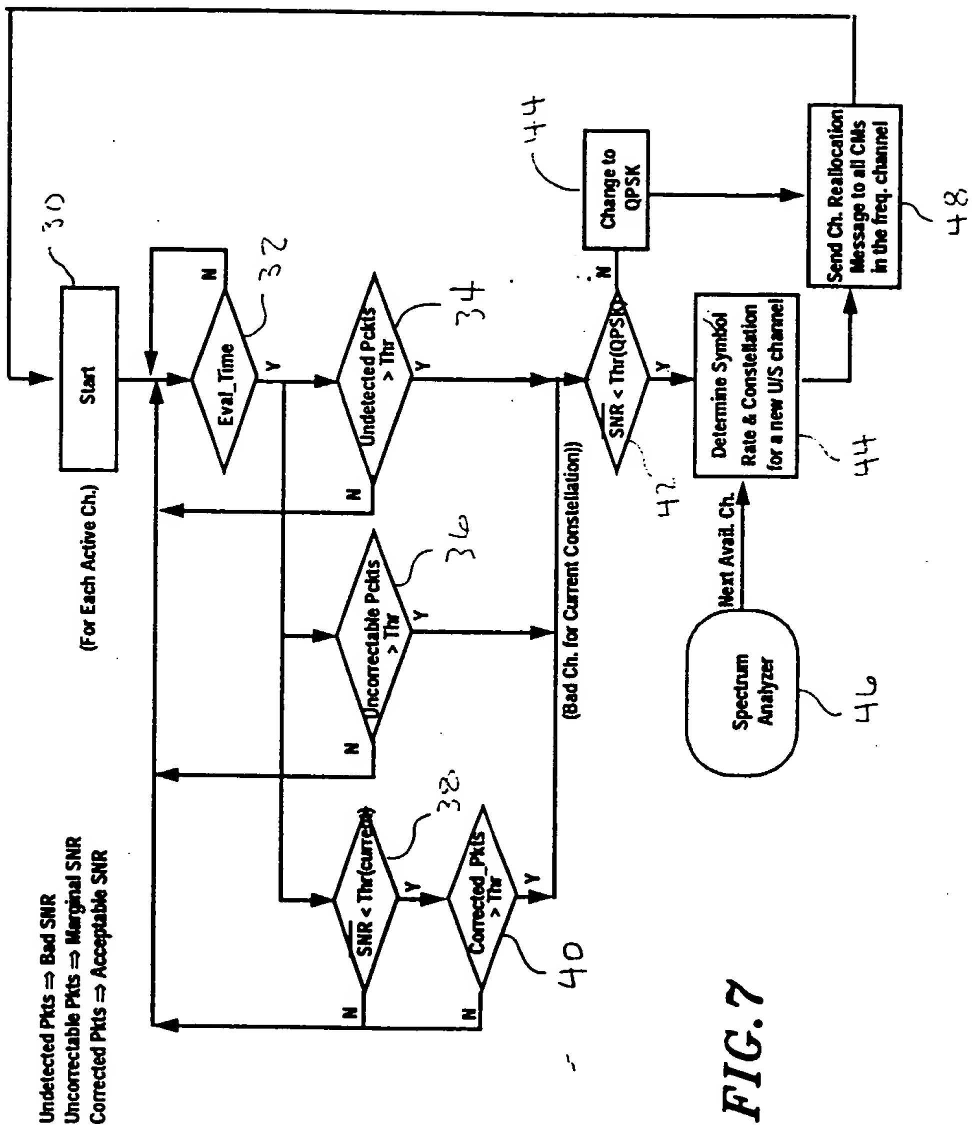


FIG.7

ROBUST TECHNIQUES FOR
OPTIMAL UPSTREAM
COMMUNICATION

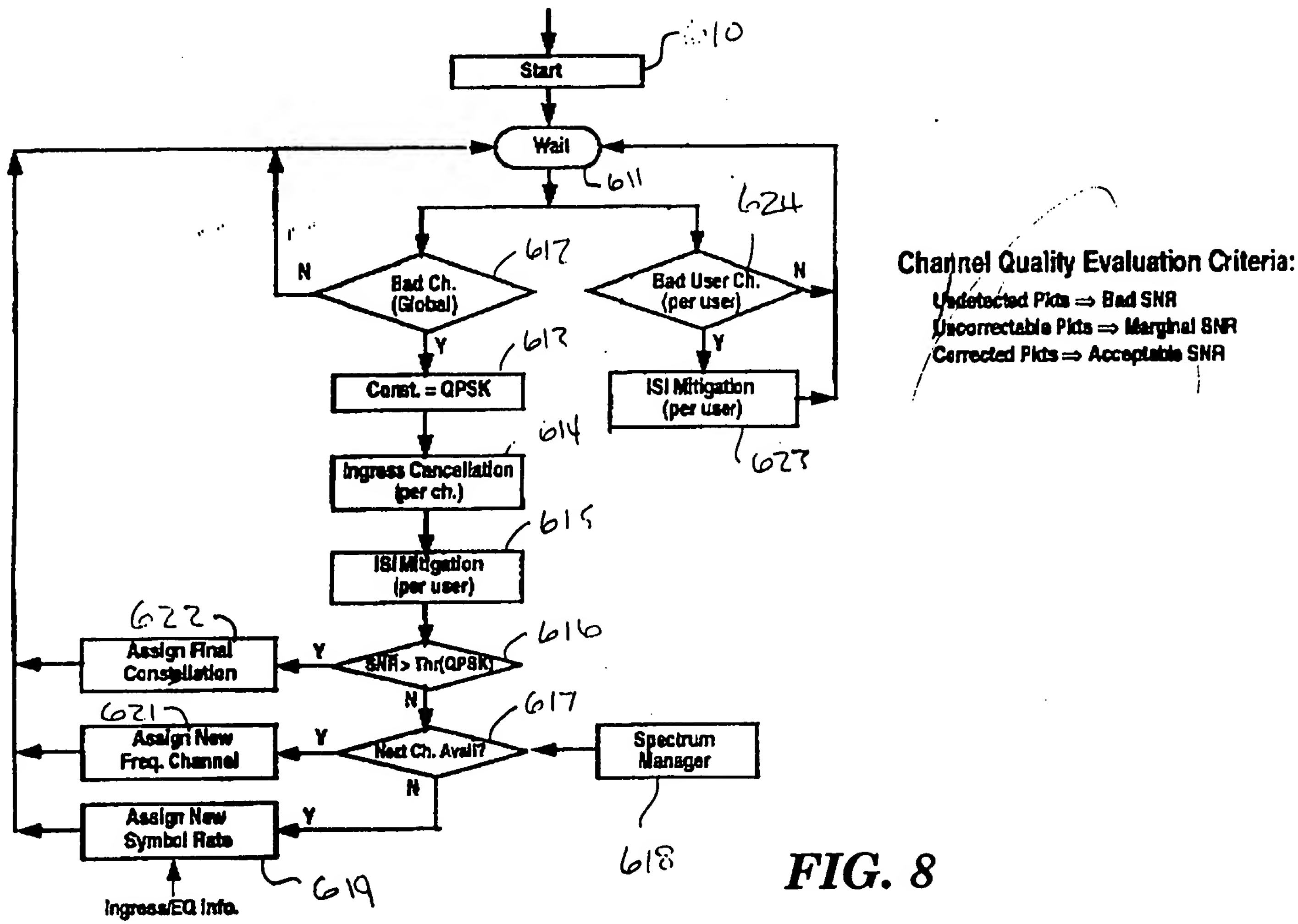


FIG. 8

ROBUST TECHNIQUES FOR
OPTIMAL UPSTREAM
COMMUNICATION

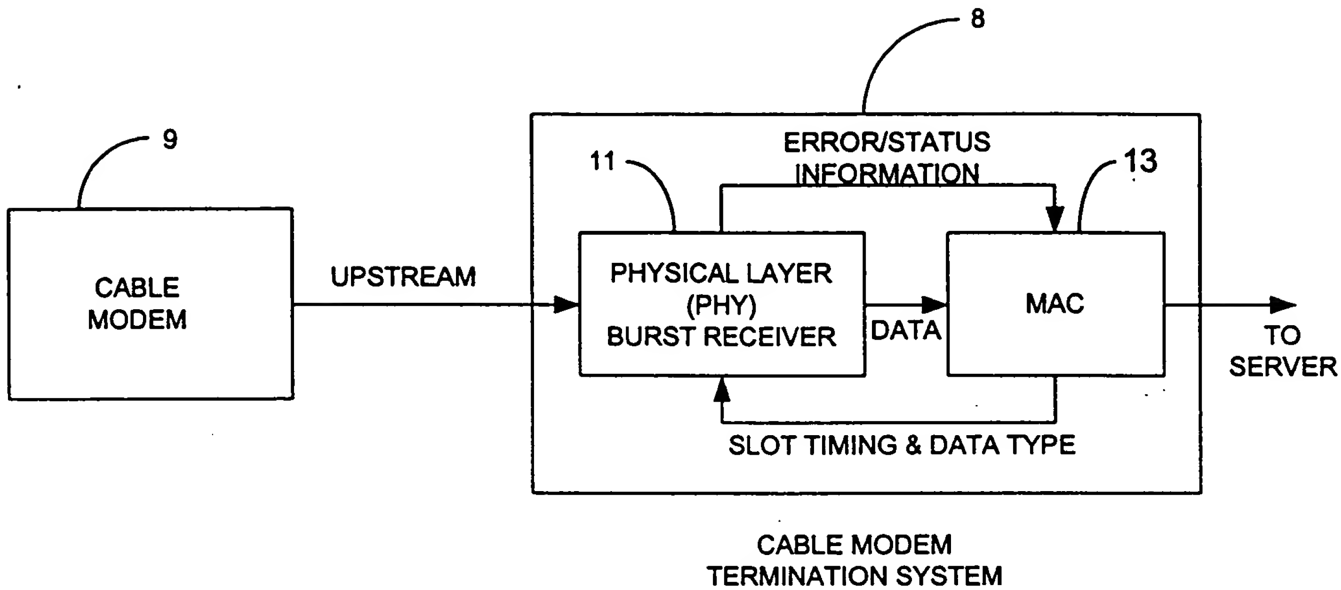


FIG. 1

CABLE MODEM
TERMINATION SYSTEM
UPSTREAM MAC/PHY
INTERFACE

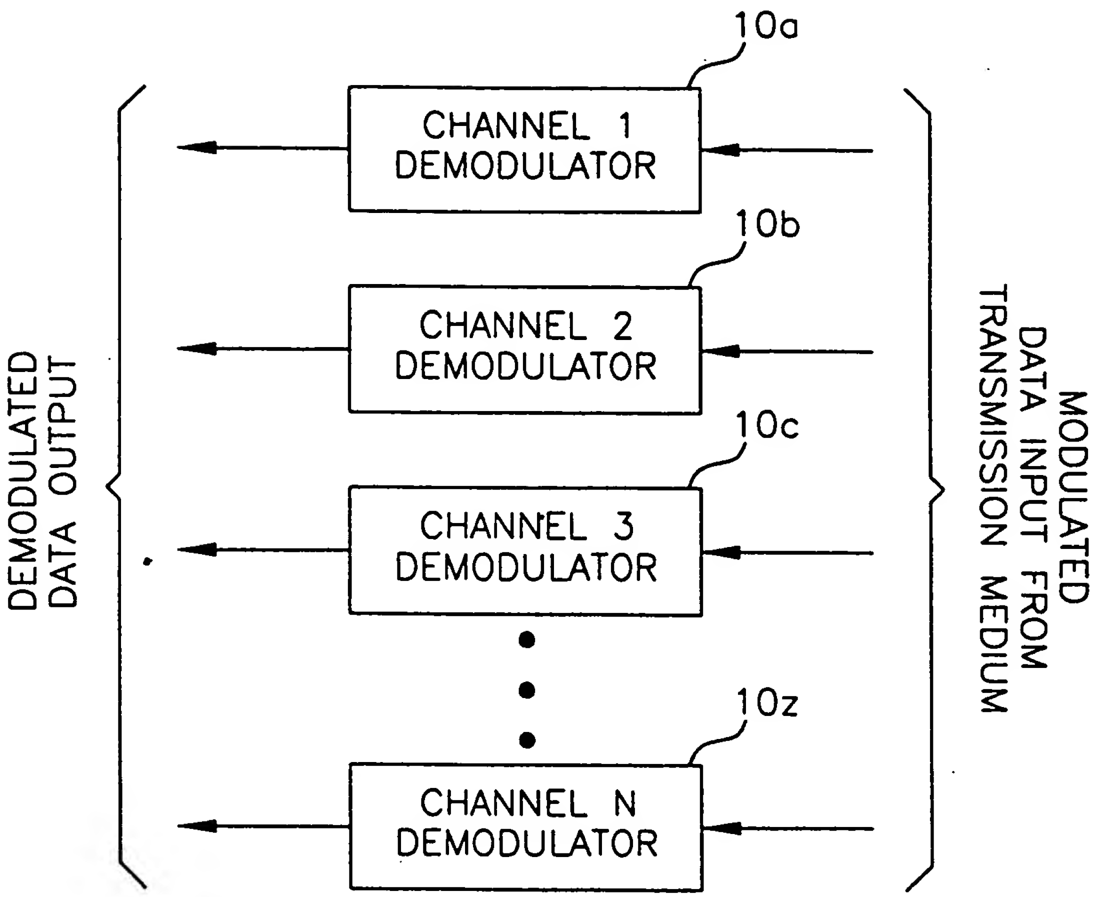


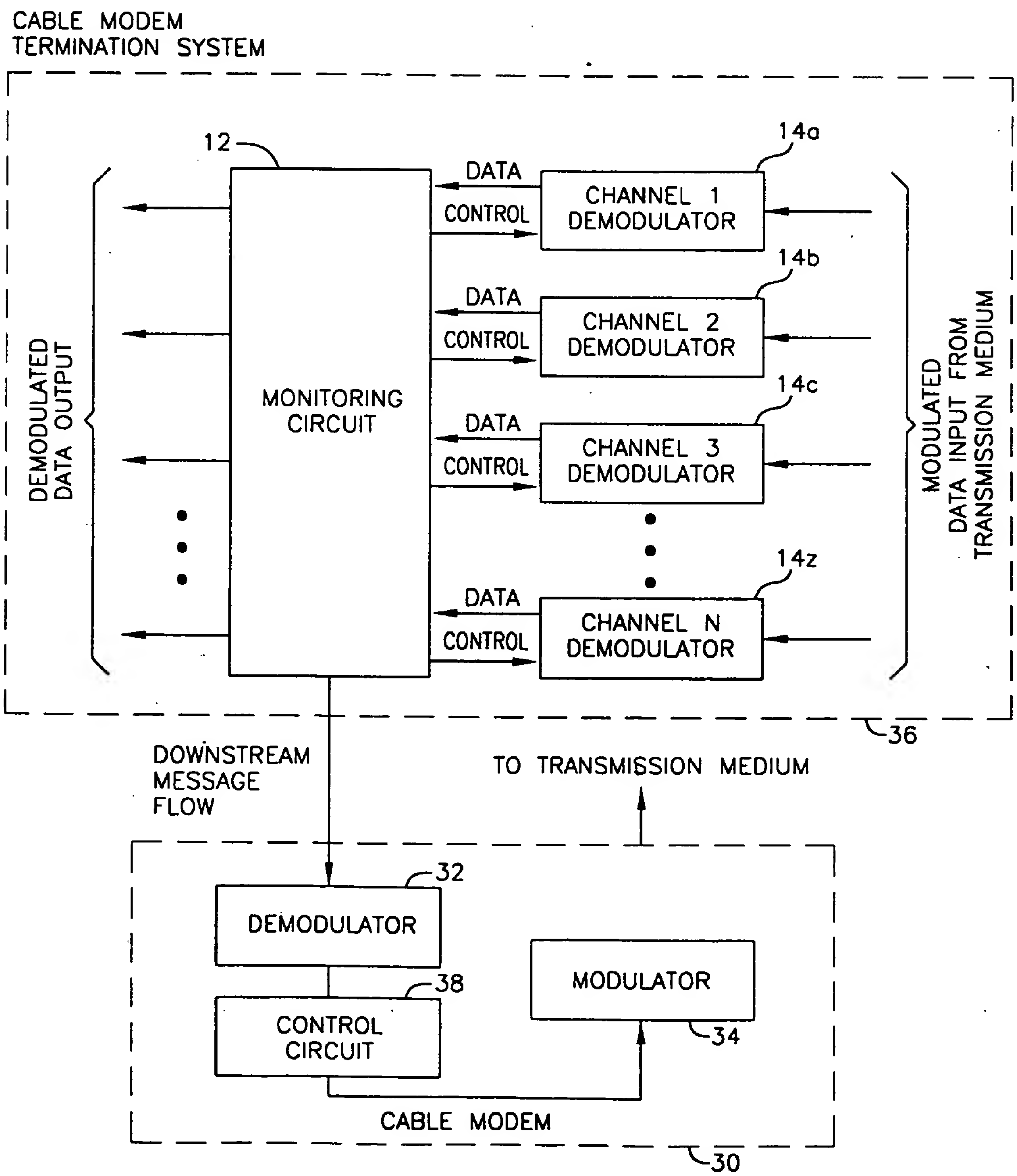
FIG. 2

(Prior Art)

CABLE MODEM
TERMINATION SYSTEM
UPSTREAM MAC/PHY
INTERFACE

CABLE MODEM
TERMINATION SYSTEM
UPSTREAM MAC/PHY
INTERFACE

FIG. 3



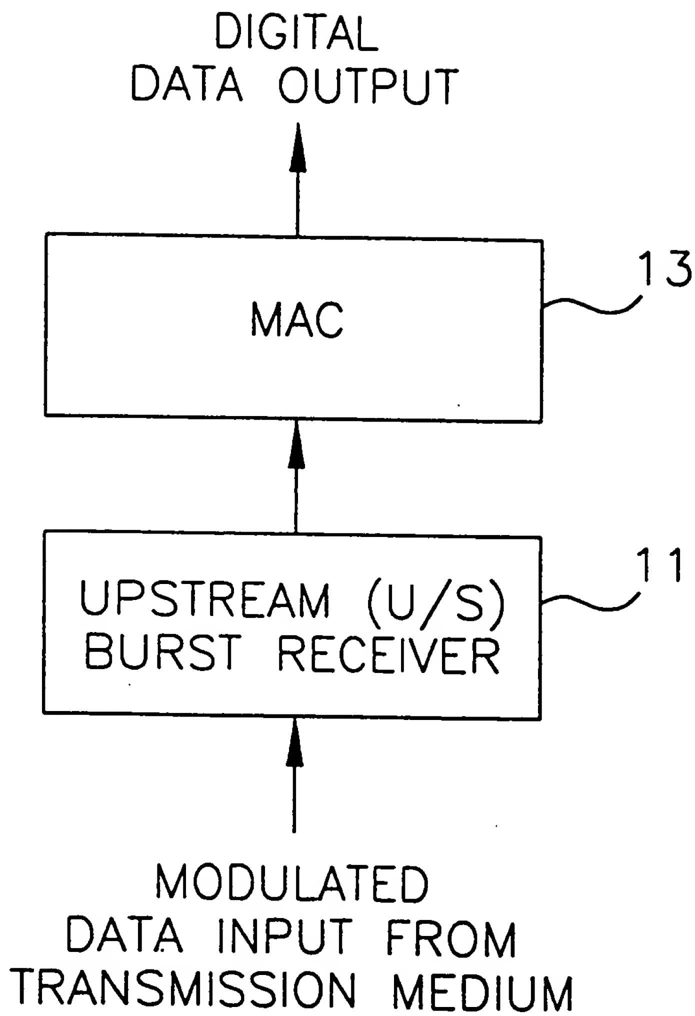


FIG. 4

(Prior Art)

CABLE MODEM
TERMINATION SYSTEM
UPSTREAM MAC/PHY
INTERFACE

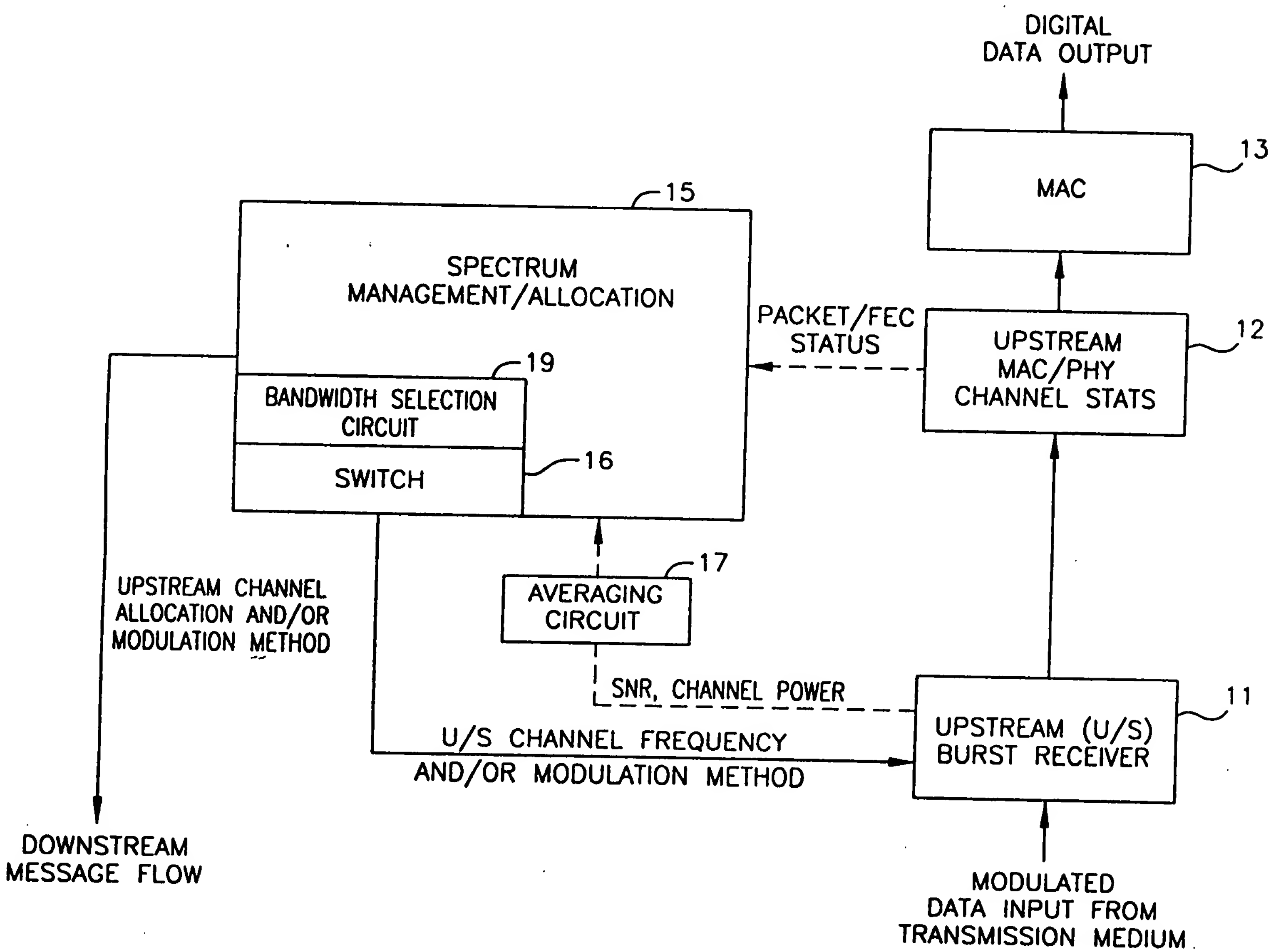


FIG. 5

CABLE MODEM
TERMINATION SYSTEM
UPSTREAM MAC/PHY
INTERFACE

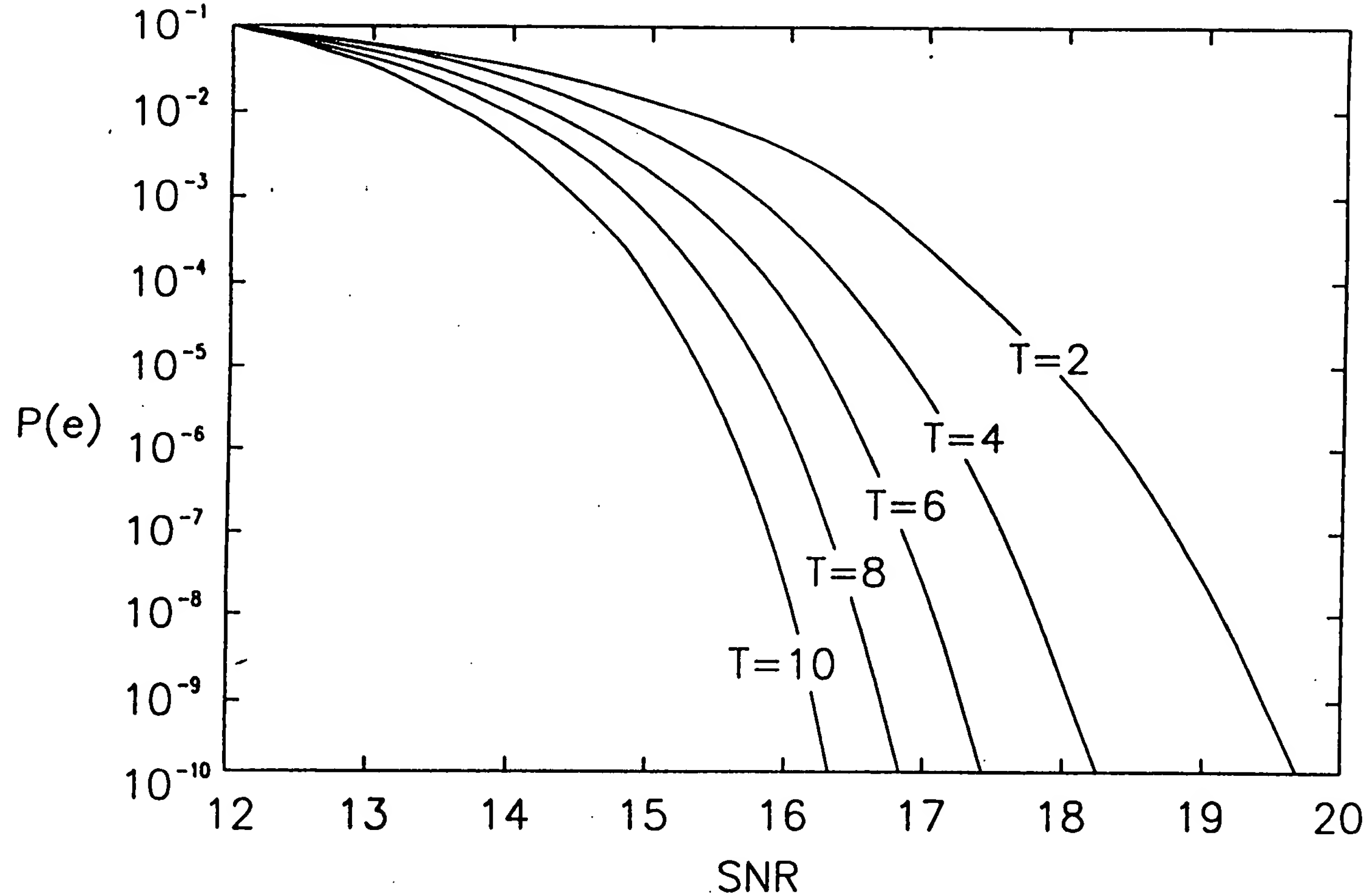


FIG. 6

CABLE MODEM
TERMINATION SYSTEM
UPSTREAM MAC/PHY
INTERFACE

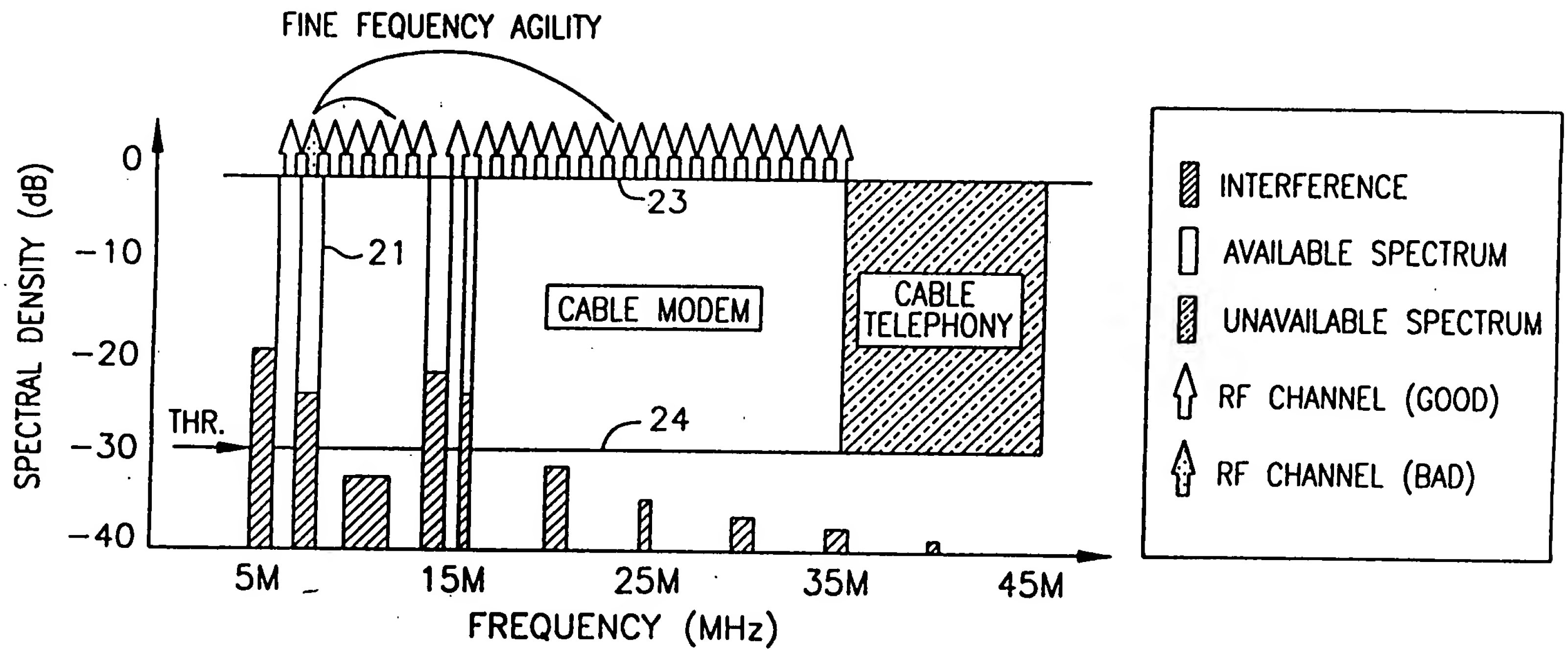


FIG. 7

CABLE MODEM
TERMINATION SYSTEM
UPSTREAM MAC/PHY
INTERFACE

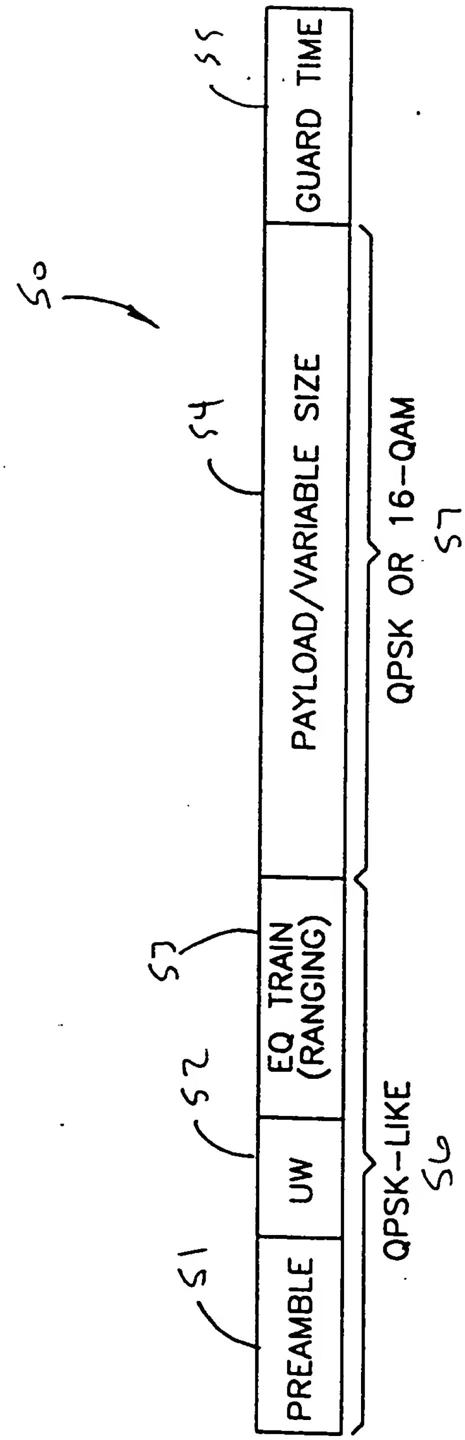


FIG. 7A

CABLE MODEM
TERMINATION SYSTEM
UPSTREAM MAC/PHY
INTERFACE

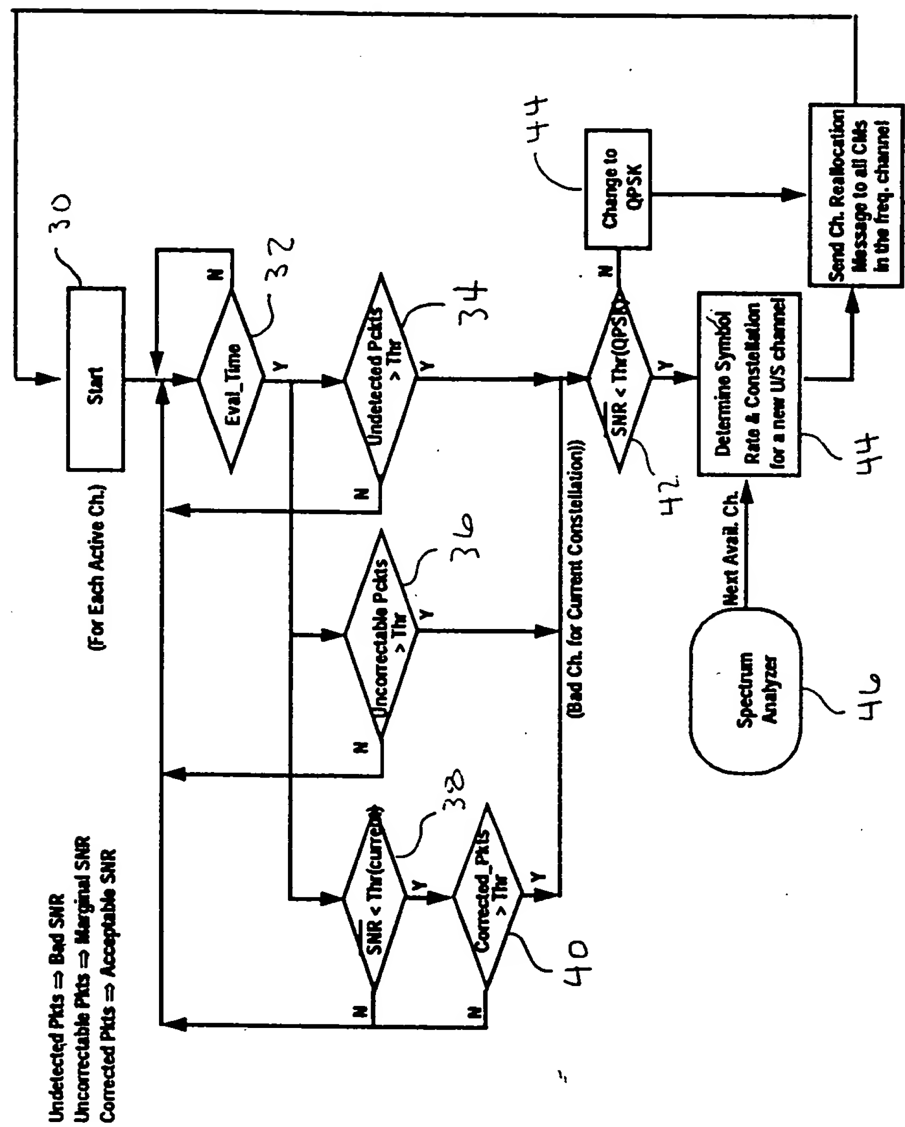


FIG. 8

CABLE MODEM
TERMINATION SYSTEM
UPSTREAM MAC/PHY
INTERFACE

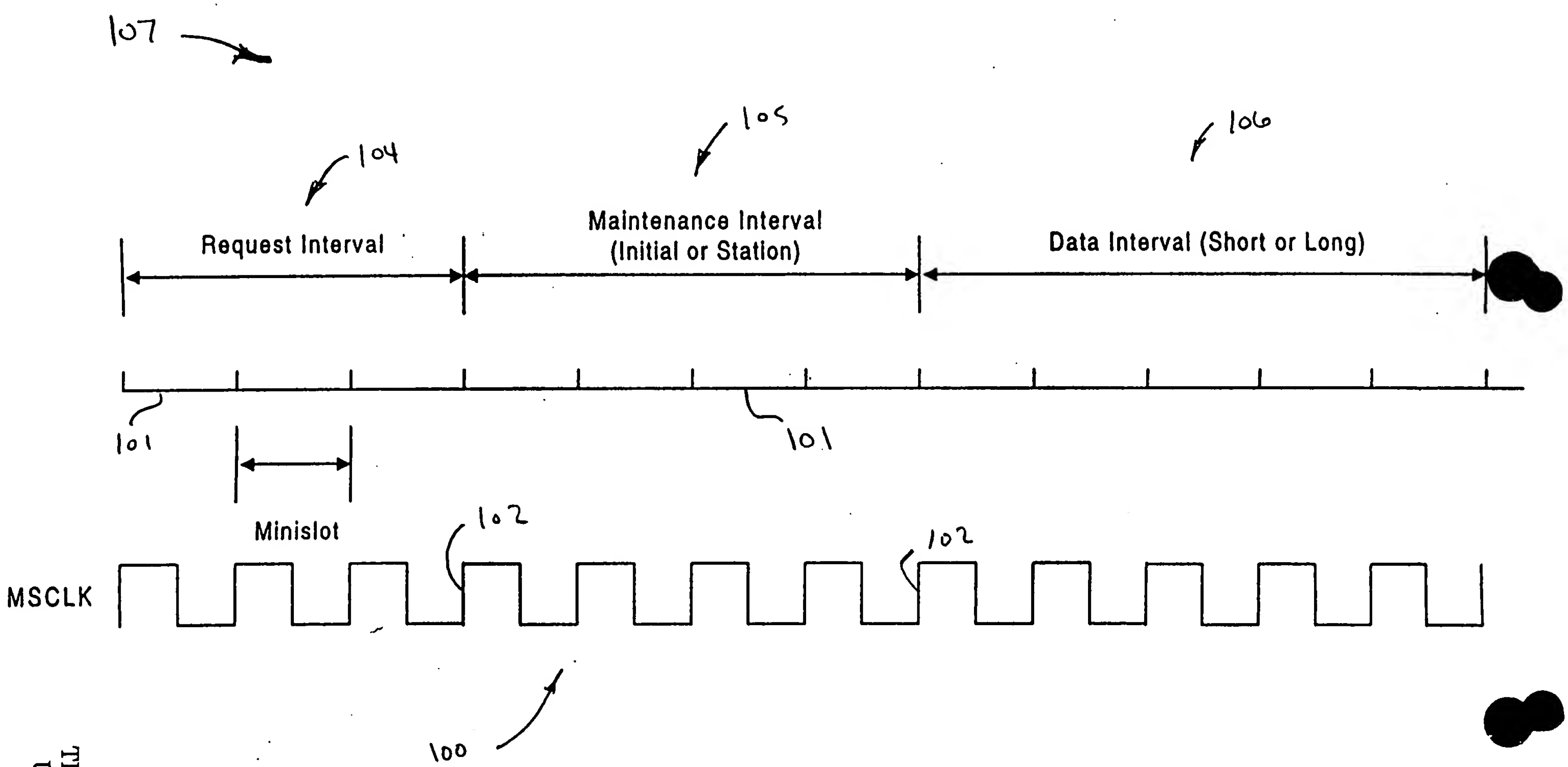
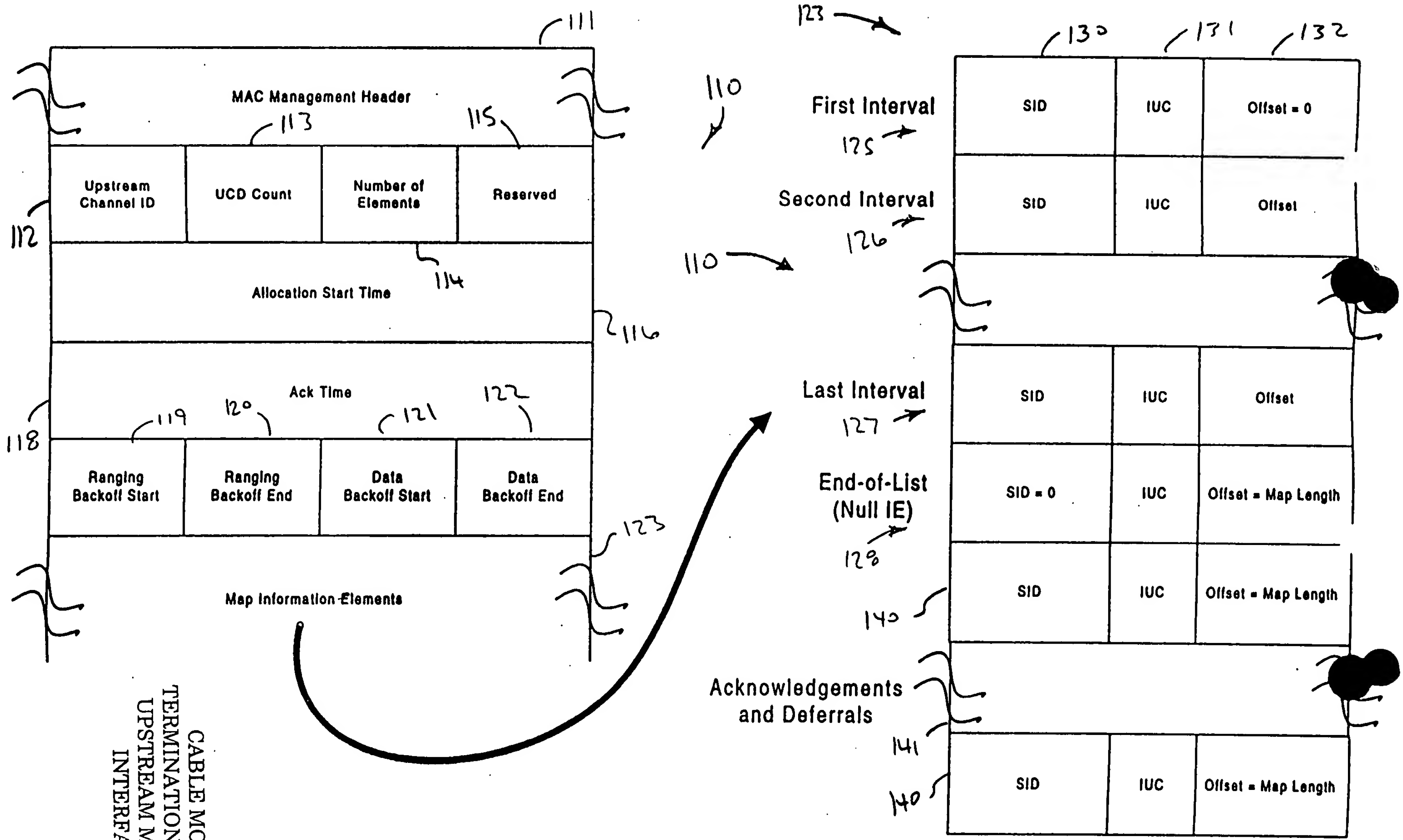


FIG. 9

CABLE MODEM
TERMINATION SYSTEM
UPSTREAM MAC/PHY
INTERFACE



CABLE MODEM TERMINATION SYSTEM UPSTREAM MAC/PHY INTERFACE

FIG. 10

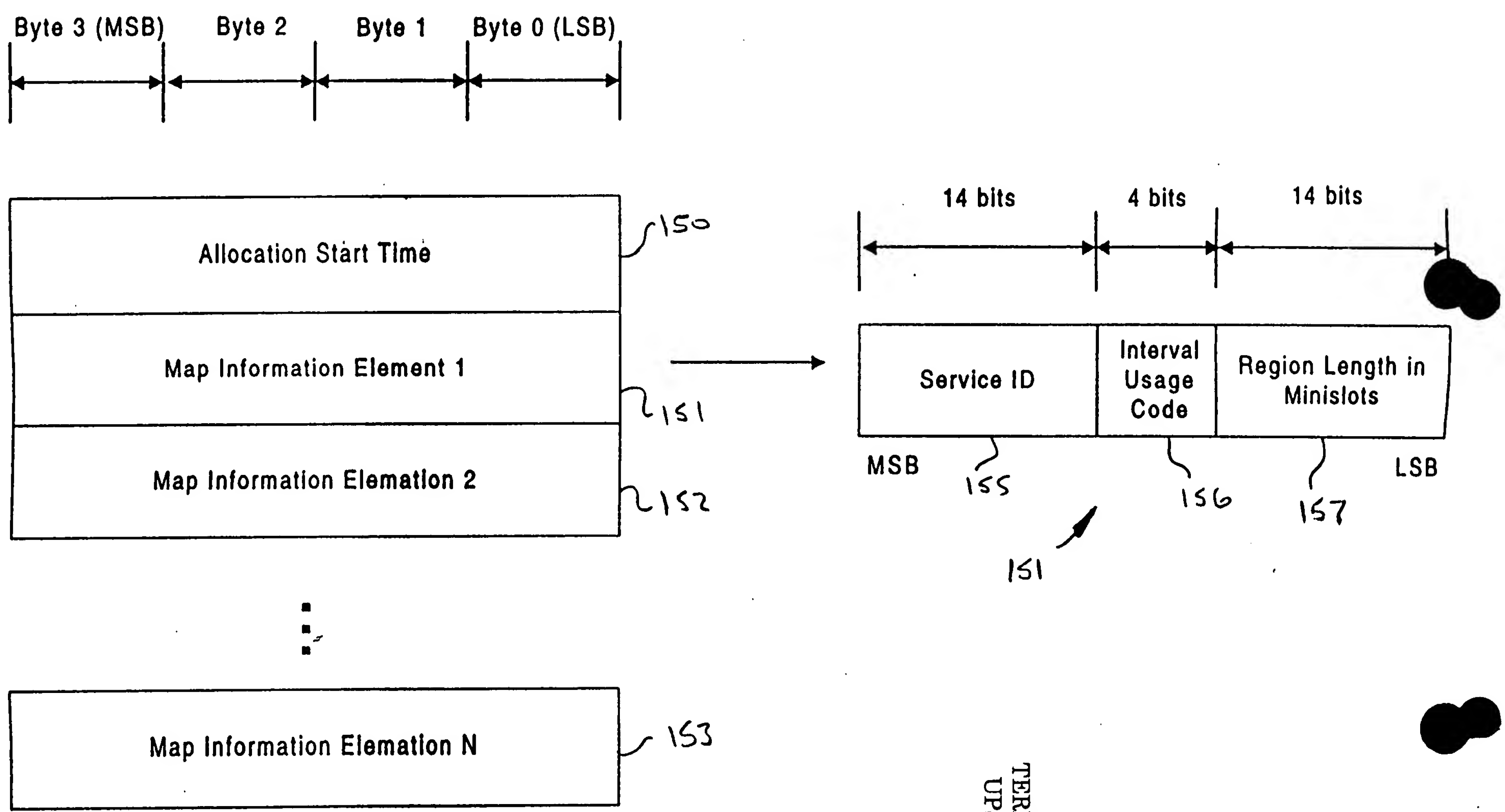


FIG. 11

CABLE MODEM
TERMINATION SYSTEM
UPSTREAM MAC/PHY
INTERFACE

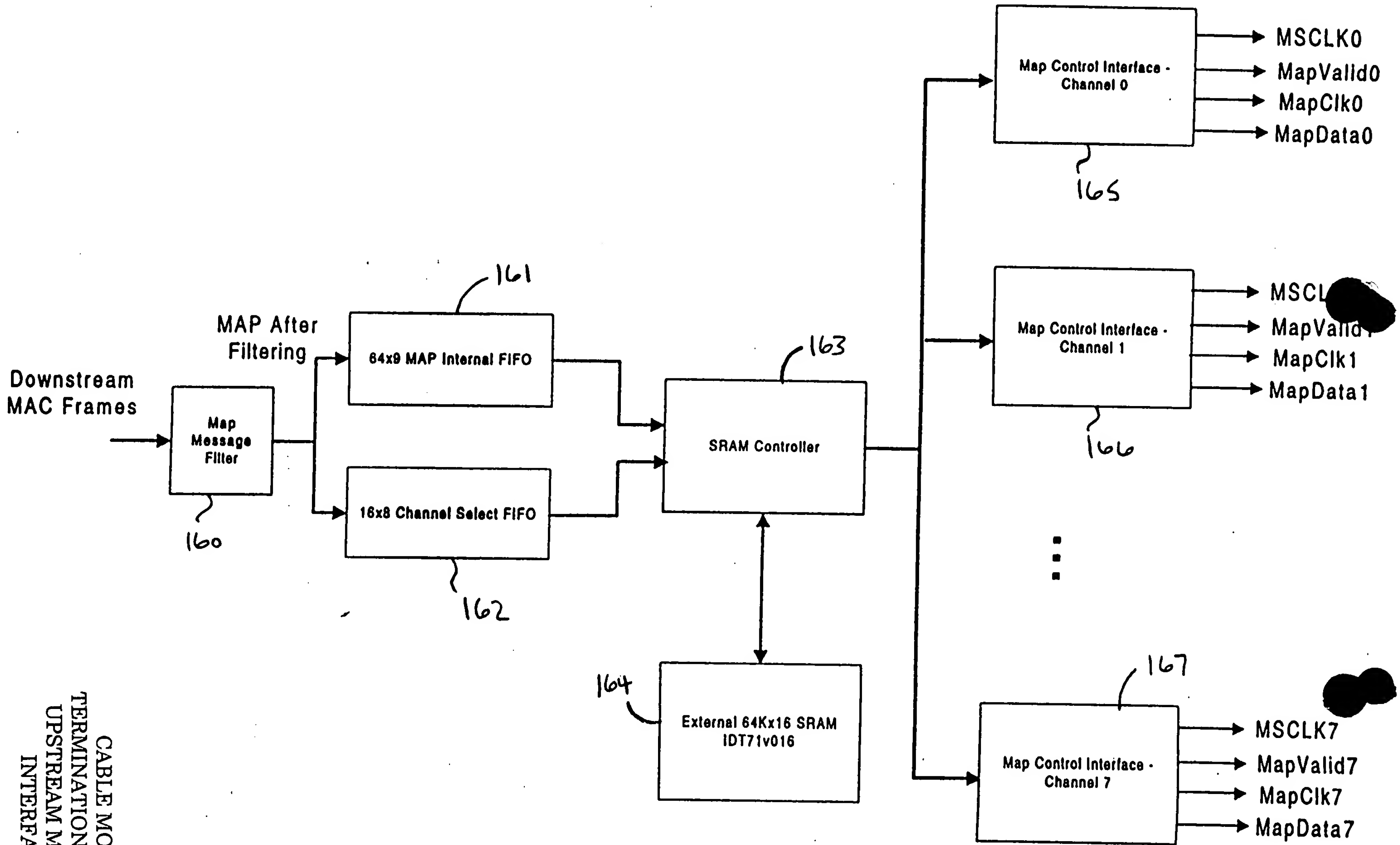


FIG. 12

CABLE MODEM
TERMINATION SYSTEM
UPSTREAM MAC/PHY
INTERFACE

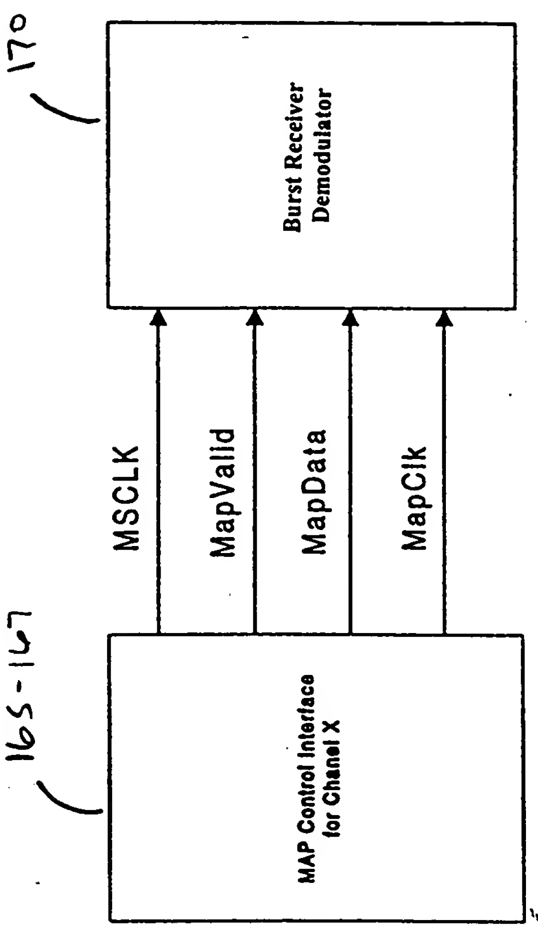
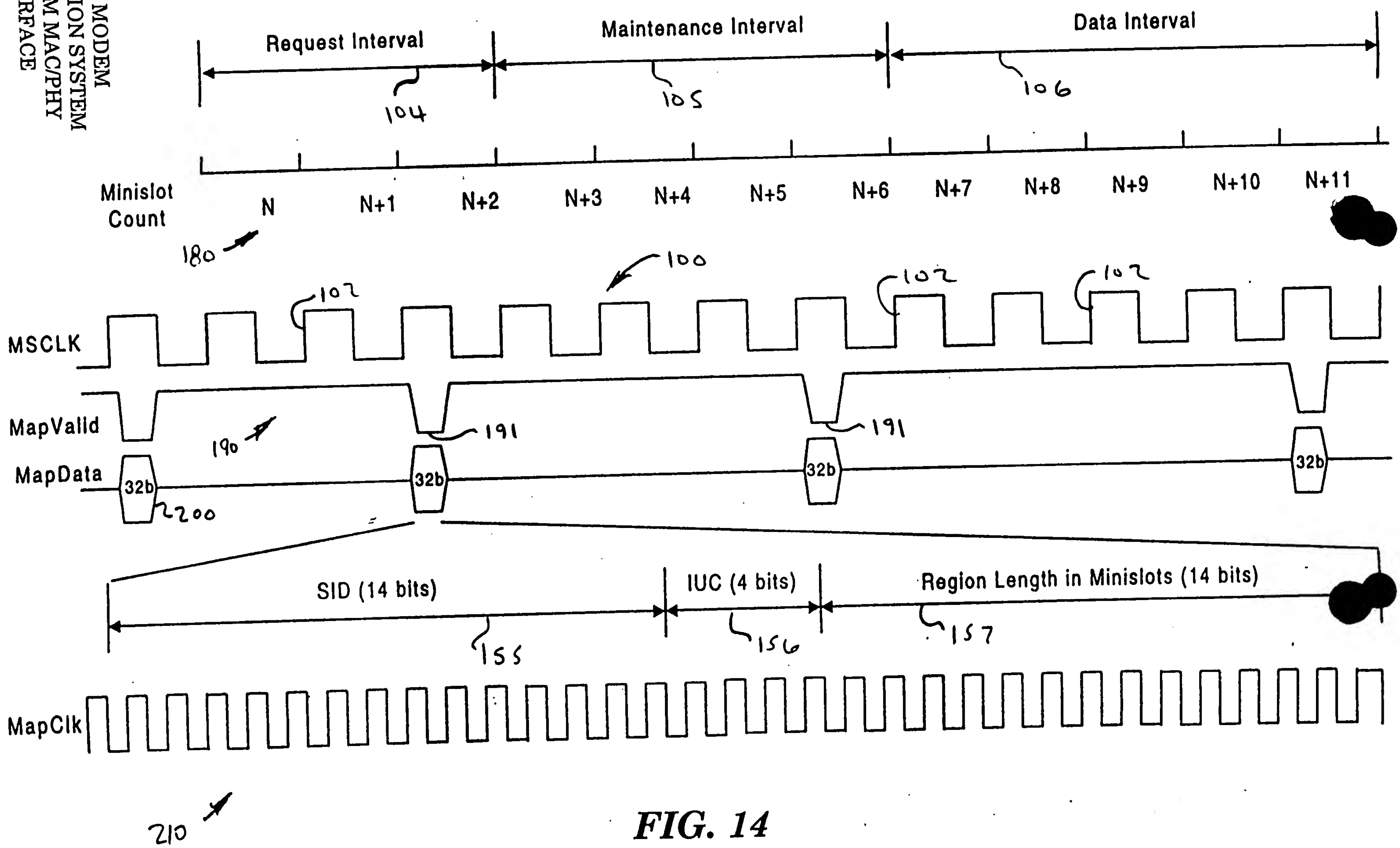


FIG. 13

CABLE MODEM
TERMINATION SYSTEM
UPSTREAM MAC/PHY
INTERFACE



CABLE MODEM TERMINATION SYSTEM UPSTREAM MAC/PHY INTERFACE

FIG. 14

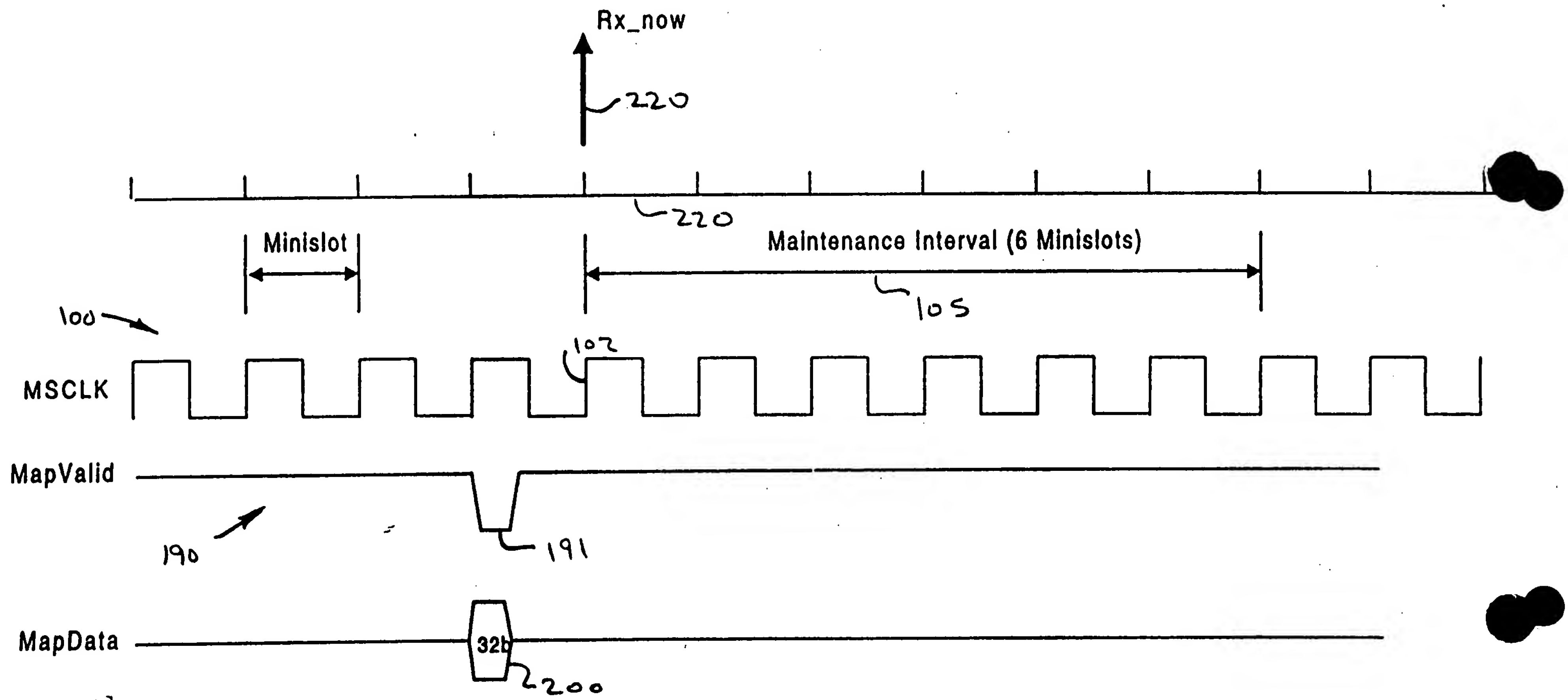


FIG. 15

CABLE MODEM
TERMINATION SYSTEM
UPSTREAM MAC/PHY
INTERFACE

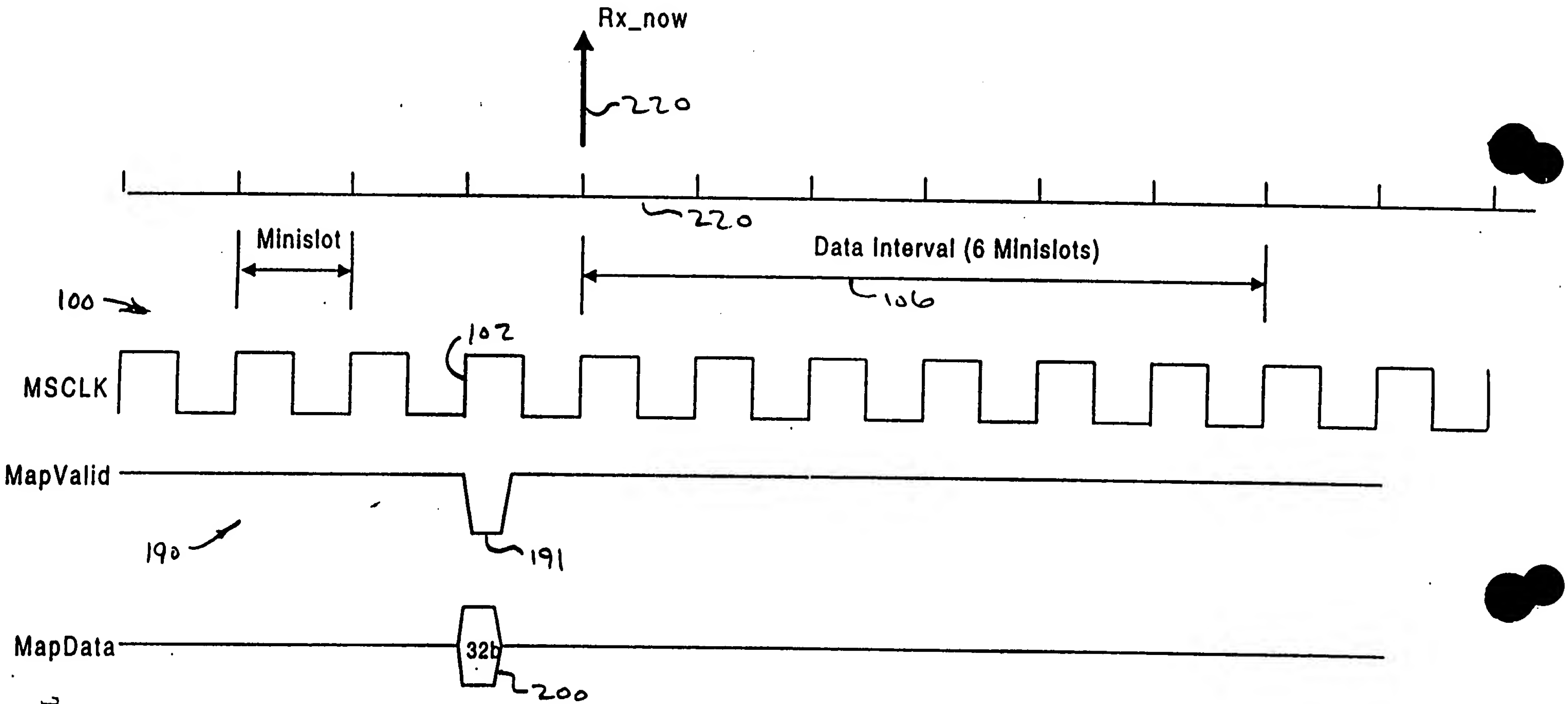
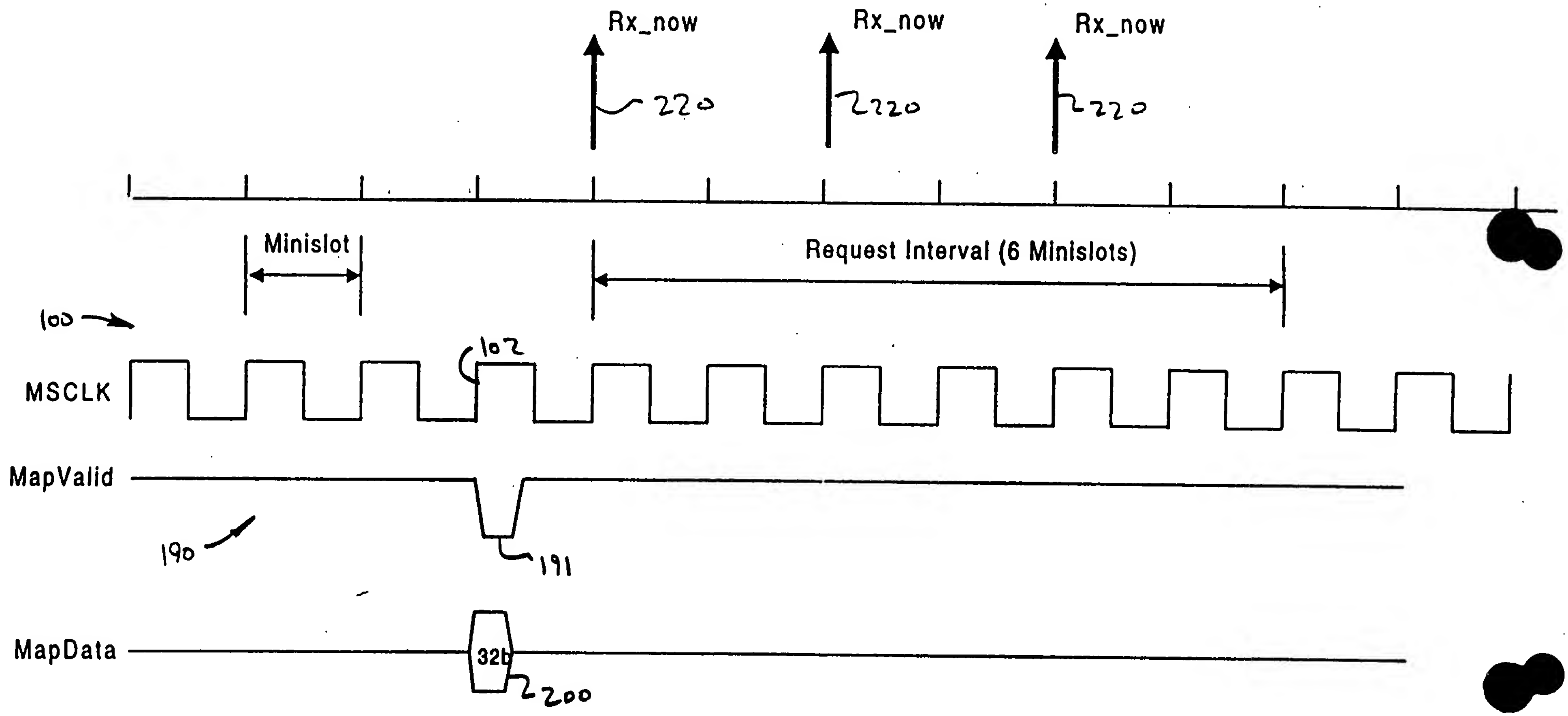


FIG. 16

CABLE MODEM TERMINATION SYSTEM UPSTREAM MAC/PHY INTERFACE



* In this example, it is assumed that each request message requires two minislots to transmit

FIG. 17

CABLE MODEM
TERMINATION SYSTEM
UPSTREAM MAC/PHY
INTERFACE

				Rng. Offset 7 bytes		
Status 2 bytes	Timestamp 4 bytes	Ch. ID 1 byte	SID 2 bytes	Pwr. 2 bytes	Freq. 2 bytes	Time 3 bytes

FIG. 18

				Rng. Offset 7 bytes			
Status 2 bytes	Timestamp 4 bytes	Ch. ID 1 byte	SID 2 bytes	Pwr. 2 bytes	Freq. 2 bytes	Time 3 bytes	Equalizer Coeffs. 32 bytes

FIG. 19

Based on the Status bytes [7:5] bits, the following statistics are kept using counters.

Slot Definition	Statistics	Calculation
Data	1. Number of slots 2. Number of Slots with power but no data 3. Number of slots with bad data 4. Number of Good data-slots 5. Total number of FEC Blocks 6. Number of FEC blocks with correctable errors. 7. Number of uncorrectable FEC blocks	 No UW UW and (Bad FEC or Bad HEC) UW and Good HEC
Request (Contention)	1. Number of requests received 2. Number of collided requests 3. Number of corrupted requests	 No UW No UW or Bad FEC or Bad HEC
Request/Data (Contention)	1. Number of packets received 2. Number of collided packets 3. Number of corrupted packets	 No UW No UW or Bad FEC or Bad HEC
Ranging	1. Number of ranging messages received 2. Number of collided ranging messages received 3. Number of corrupted ranging messages	 No UW No UW or Bad FEC or Bad HEC

FIG. 20

CABLE MODEM
TERMINATION SYSTEM
UPSTREAM MAC/PHY
INTERFACE

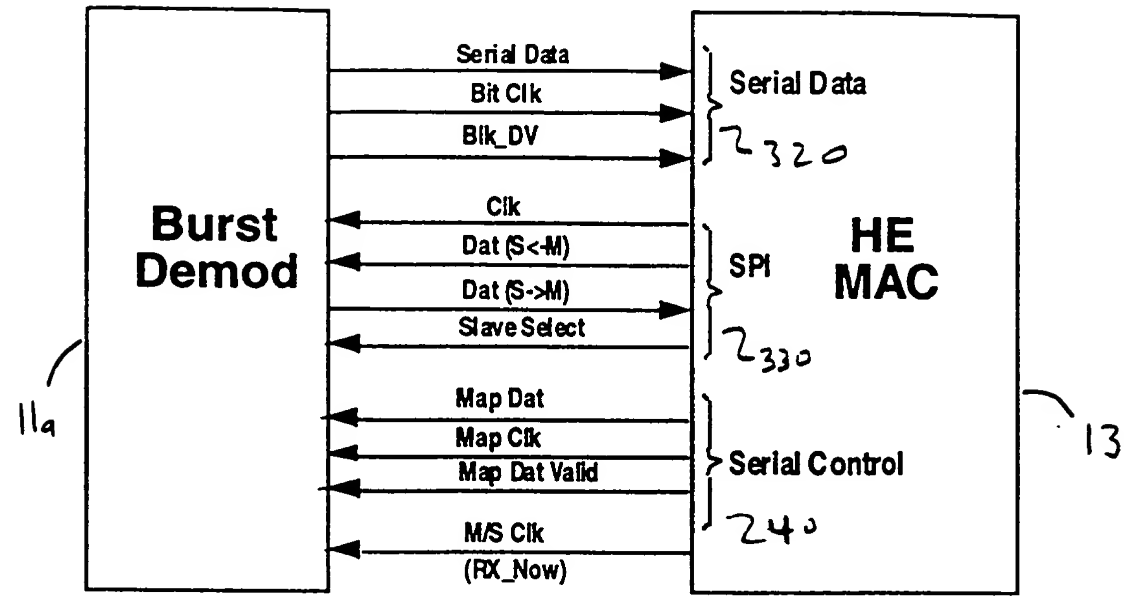


FIG. 21

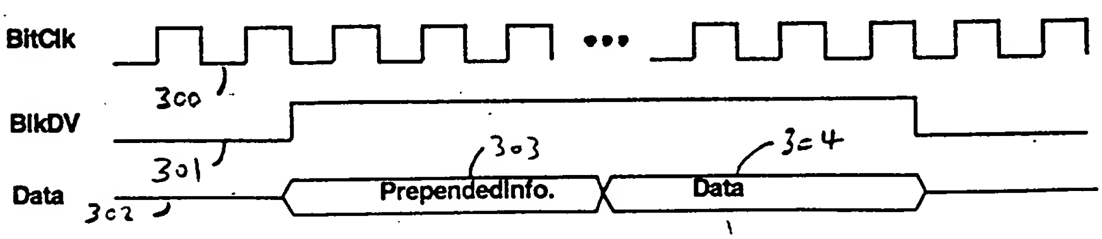


FIG. 22

CABLE MODEM
TERMINATION SYSTEM
UPSTREAM MAC/PHY
INTERFACE

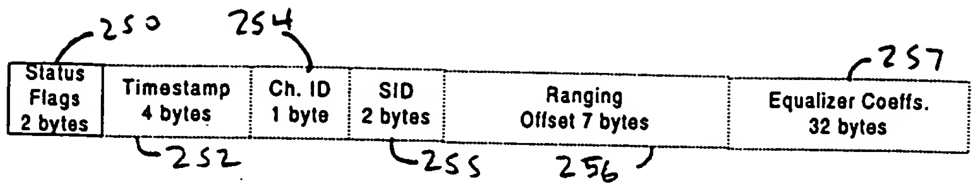


FIG. 23

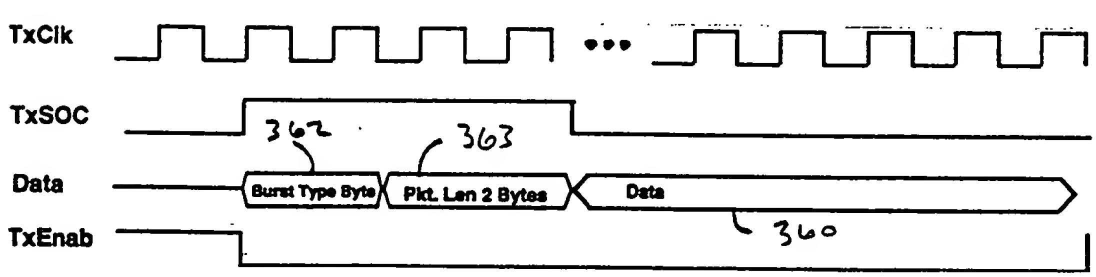
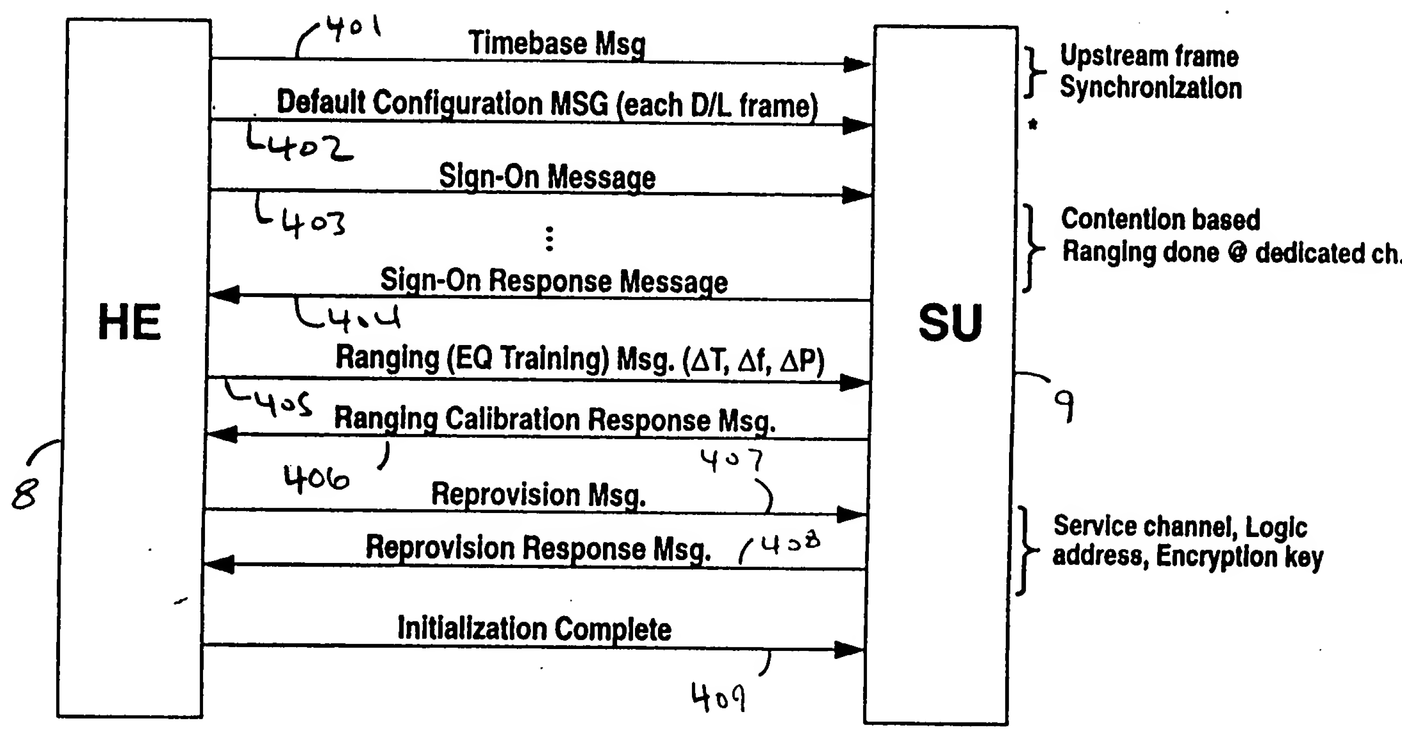


FIG. 24

CABLE MODEM
TERMINATION SYSTEM
UPSTREAM MAC/PHY
INTERFACE

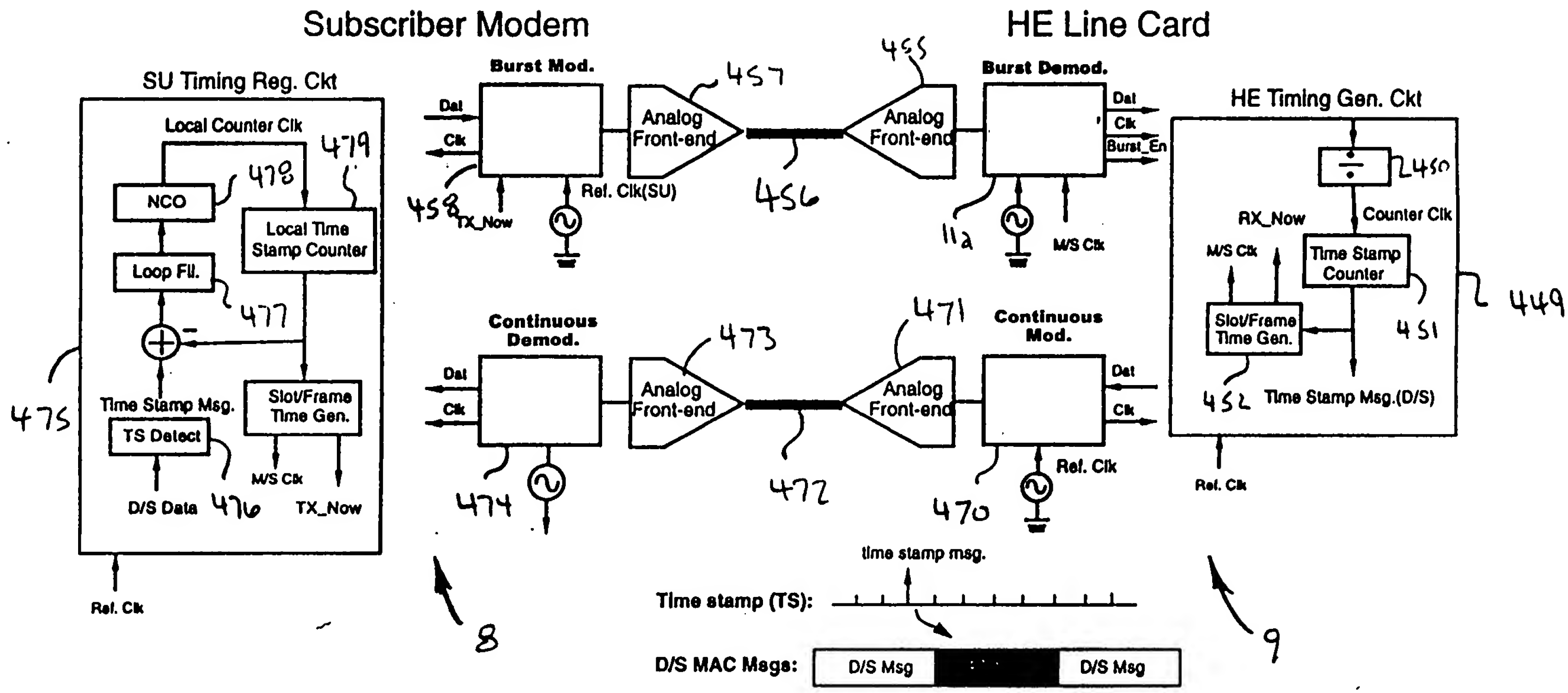
- **Sign-On Sequence** (plug-&-play based registration)



* Default Configuration Msg: Ranging channel frequency, Transmission rate Initial pwr level, Contention-based access slot information, etc.

FIG. 25

CABLE MODEM TERMINATION SYSTEM UPSTREAM MAC/PHY INTERFACE



- MAC framing and PHY framing are decoupled
- Upstream frame synchronization based on time stamp messages

FIG. 26

CABLE MODEM
TERMINATION SYSTEM
UPSTREAM MAC/PHY
INTERFACE

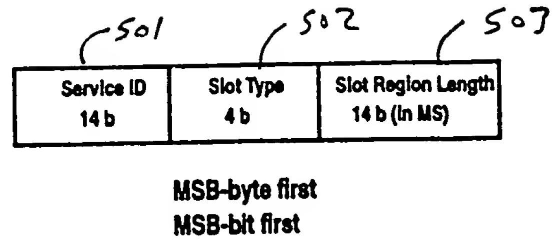


FIG. 27

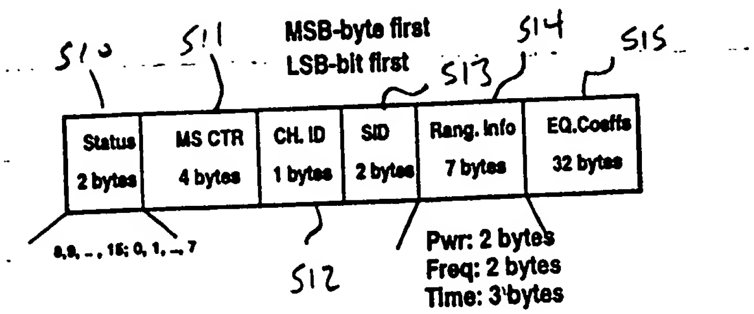


FIG. 28

CABLE MODEM
TERMINATION SYSTEM
UPSTREAM MAC/PHY
INTERFACE

Bit Field	Definition if Bit[11]=1	Definition if Bit[11]=0
Bit[15:12]	MCNS IUC	Reserved
Bit [11]	1: Indicates 1st block of transmission	0: Indicates not 1st block of transmission
Bit [10]	1: Indicates last block of transmission	1: Indicates last block of transmission
Bit [9]	1: Indicates Ranging required	Reserved
Bit [8]	Reserved	Reserved
Bit [7:5]	000: FEC OK 001: Correctable FEC Error 010: uncorrectable FEC error 011: no Unique word detected 100: collided packet 101: no energy 110: packet length violation	000: FEC OK 001: Correctable FEC Error 010: uncorrectable FEC error 011: no Unique word detected 100: collided packet 101: no energy 110: packet length violation
Bit [4]	1: Valid Minislot count prepended	Reserved
Bit [3]	1: Valid Channel ID prepended	Reserved
Bit [2]	1: Valid SID prepended	Reserved
Bit [1]	1: Ranging info prepended	Reserved
Bit [0]	1: Equalizer coefficients prepended	Reserved

FIG. 29

CABLE MODEM
TERMINATION SYSTEM
UPSTREAM MAC/PHY
INTERFACE

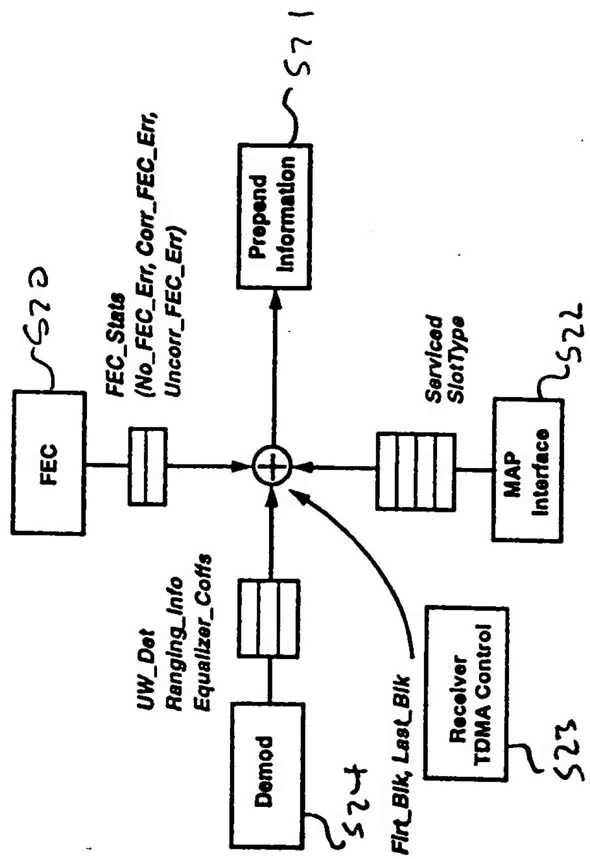


FIG. 30

CABLE MODEM
TERMINATION SYSTEM
UPSTREAM MAC/PHY
INTERFACE

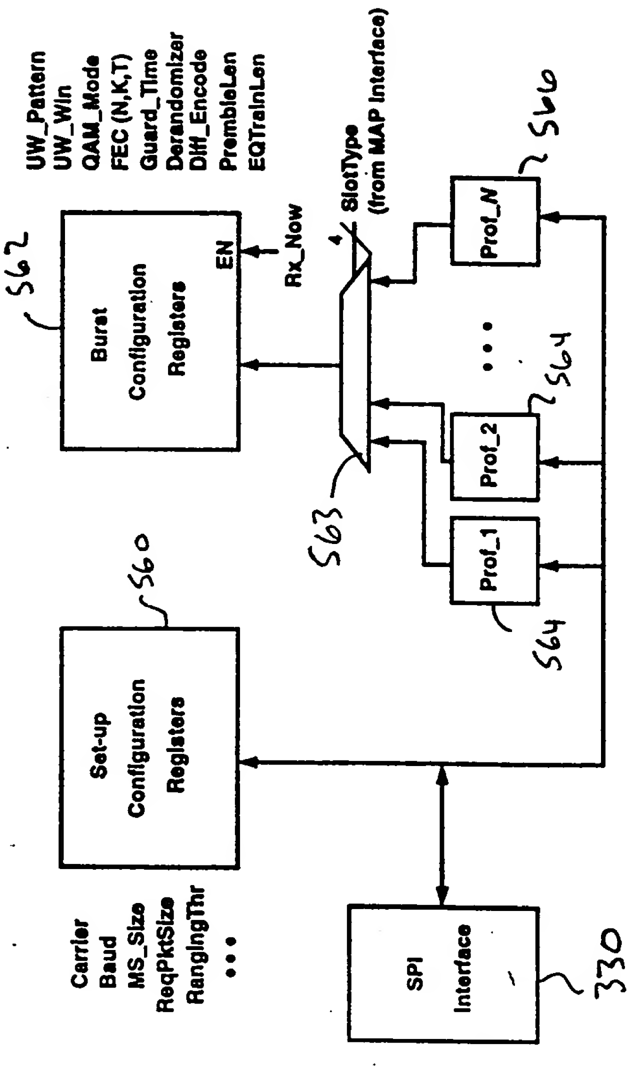


FIG. 31

CABLE MODEM
TERMINATION SYSTEM
UPSTREAM MAC/PHY
INTERFACE

CABLE MODEM
TERMINATION SYSTEM
UPSTREAM MAC/PHY
INTERFACE

FIG.32

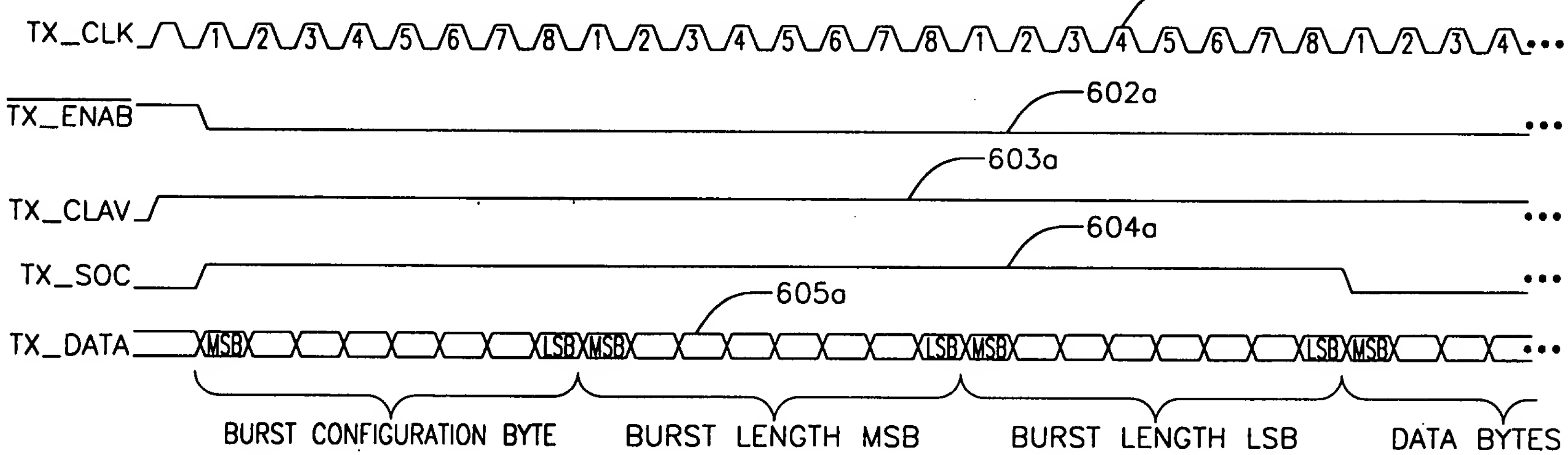


FIG.33

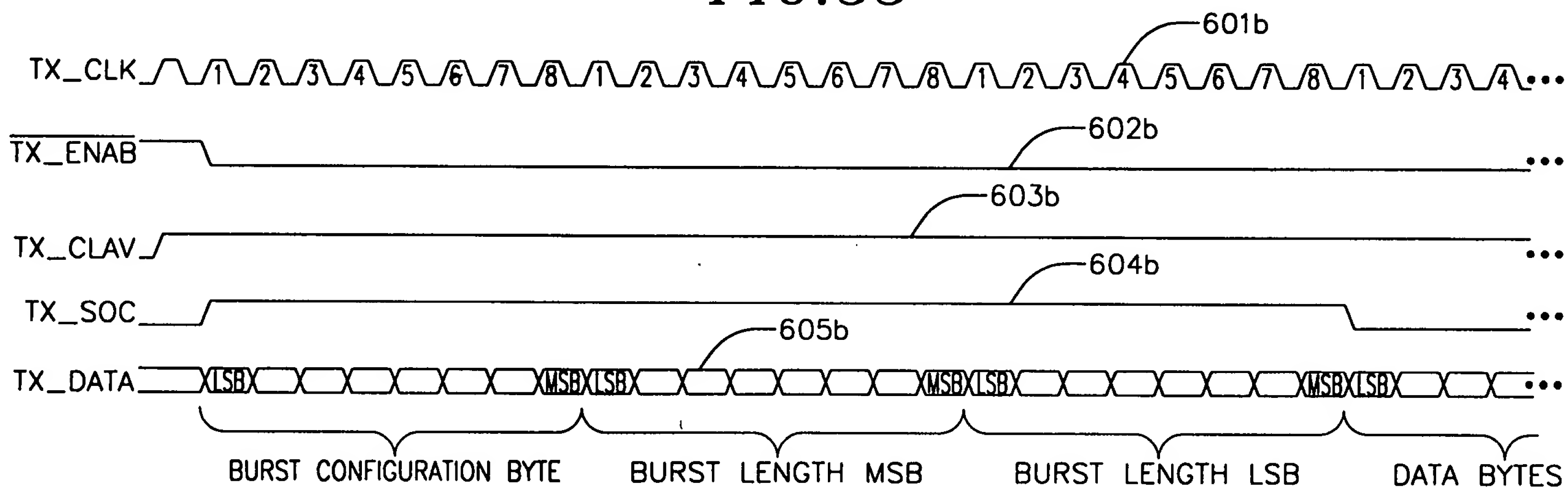
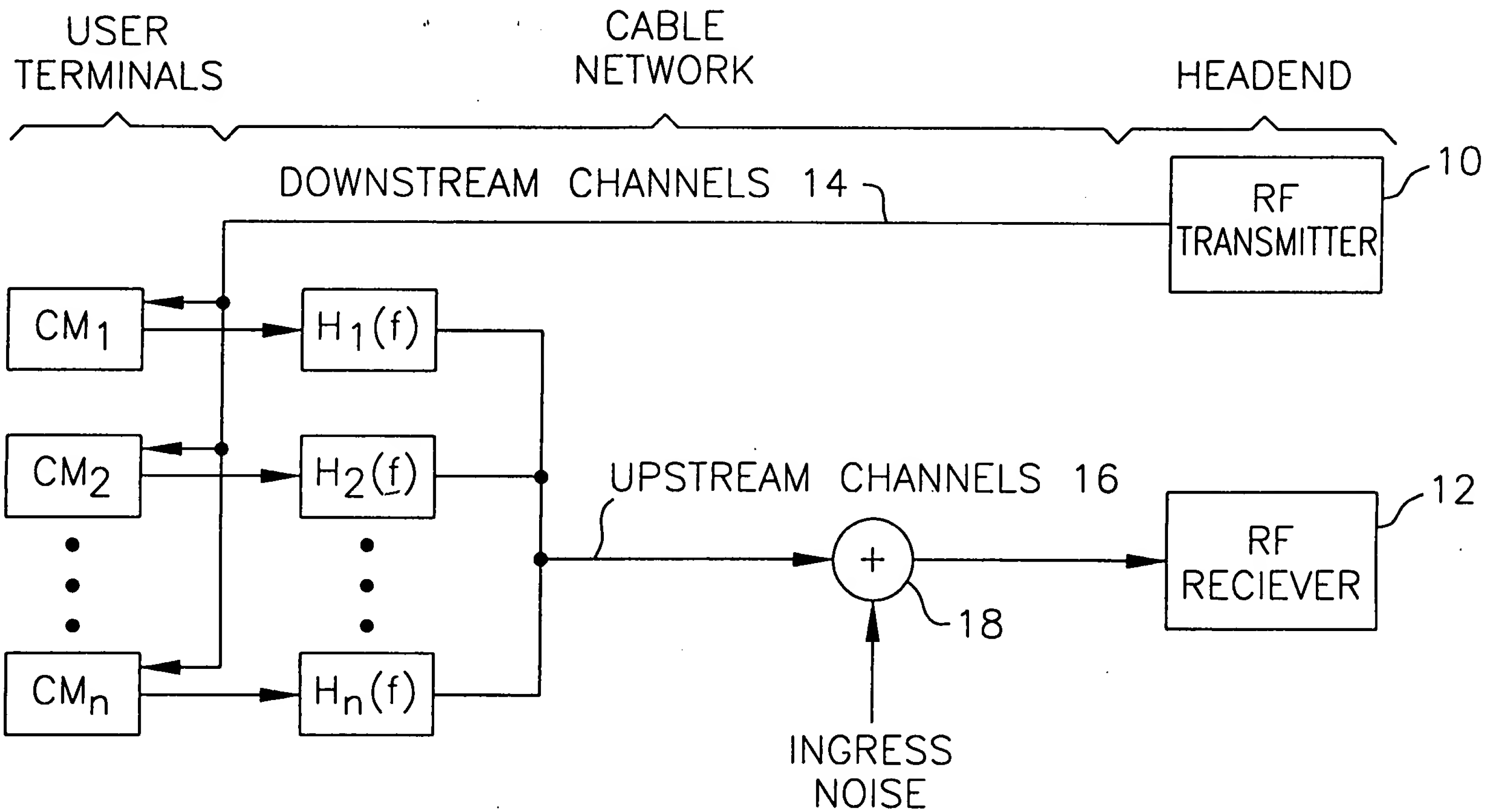
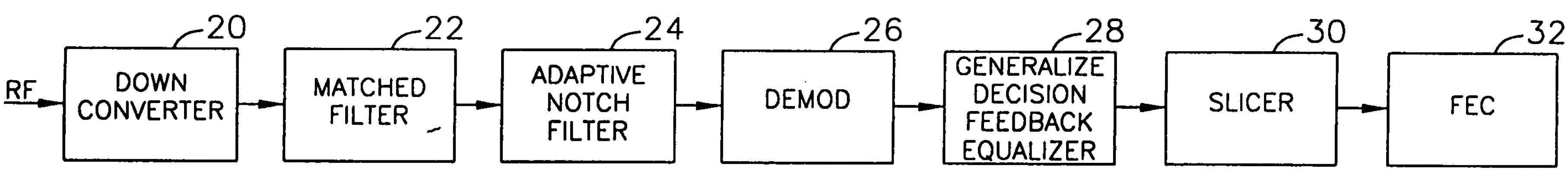


FIG. 1



METHOD AND APPARATUS FOR REDUCING NOISE IN A BIDIRECTIONAL CABLE TRANSMISSION SYSTEM

FIG.2



METHOD AND APPARATUS
FOR REDUCING NOISE IN A
BIDIRECTIONAL CABLE
TRANSMISSION SYSTEM

FIG.3

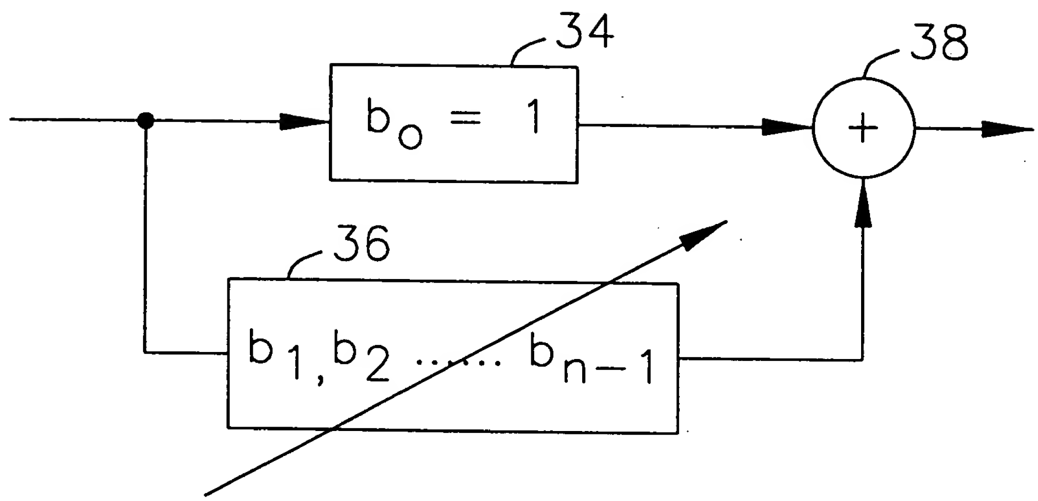
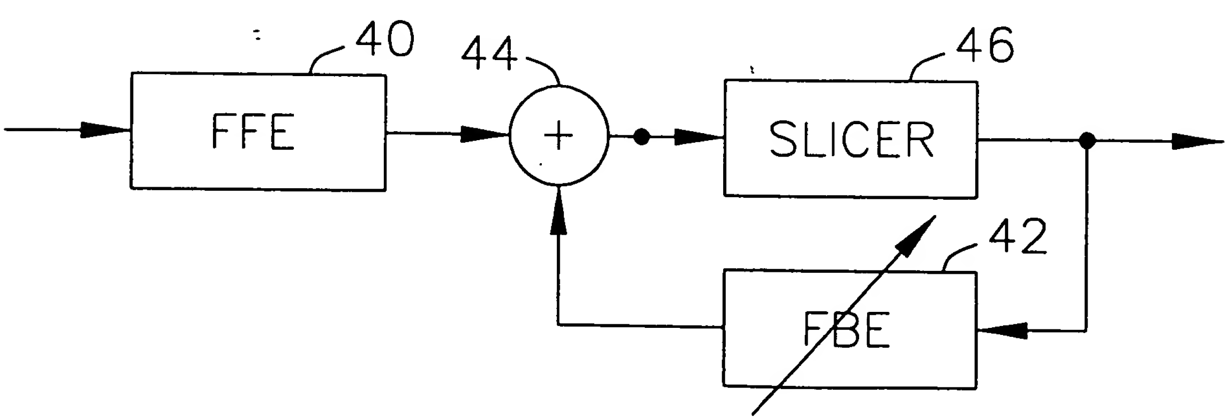
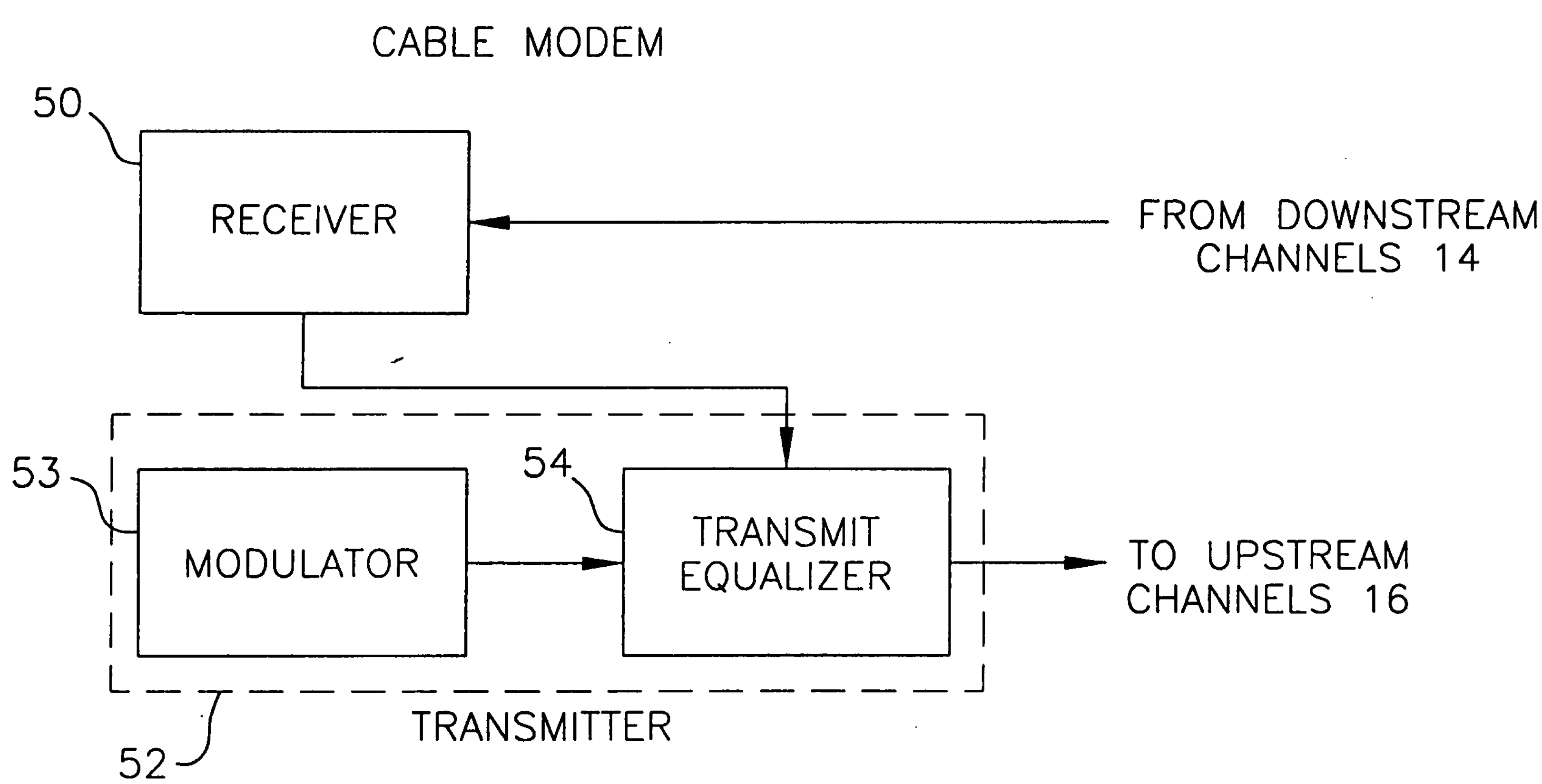


FIG.4



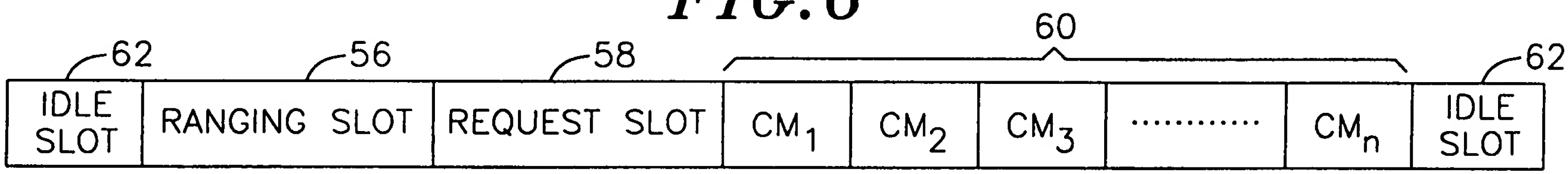
METHOD AND APPARATUS FOR REDUCING NOISE IN A BIDIRECTIONAL CABLE TRANSMISSION SYSTEM

FIG.5



METHOD AND APPARATUS FOR REDUCING NOISE IN A BIDIRECTIONAL CABLE TRANSMISSION SYSTEM

FIG.6



METHOD AND APPARATUS
FOR REDUCING NOISE IN A
BIDIRECTIONAL CABLE
TRANSMISSION SYSTEM

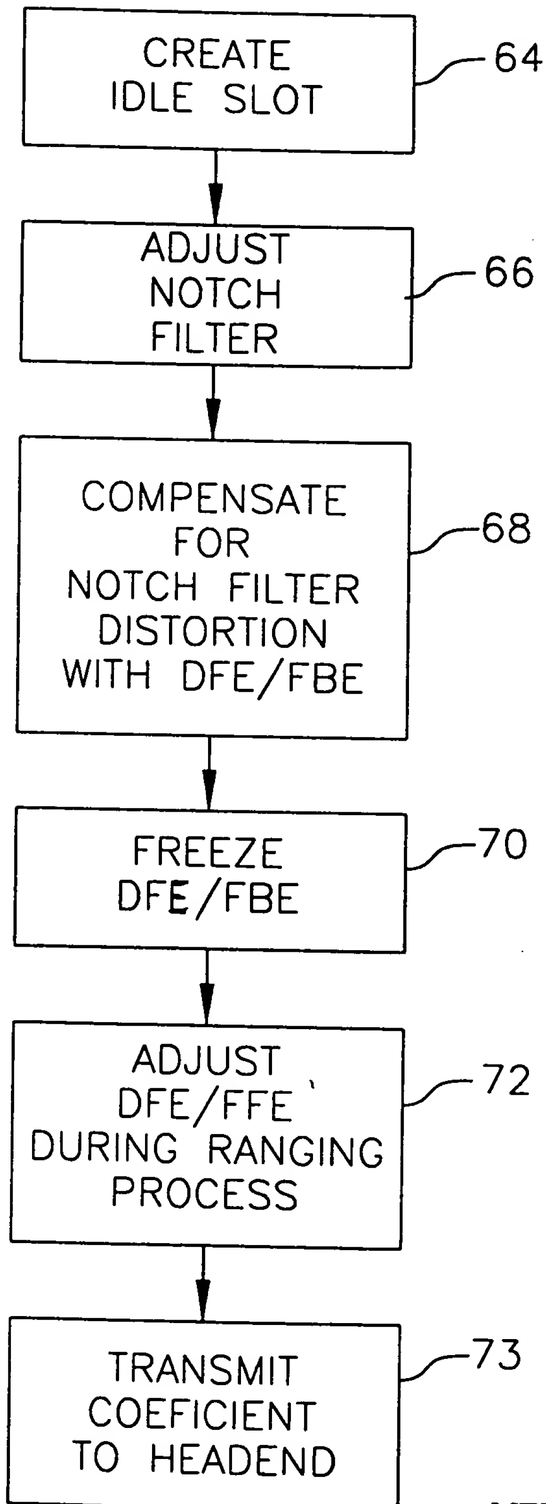


FIG. 7

METHOD AND APPARATUS FOR REDUCING NOISE IN A BIDIRECTIONAL CABLE TRANSMISSION SYSTEM

FIG. 8A

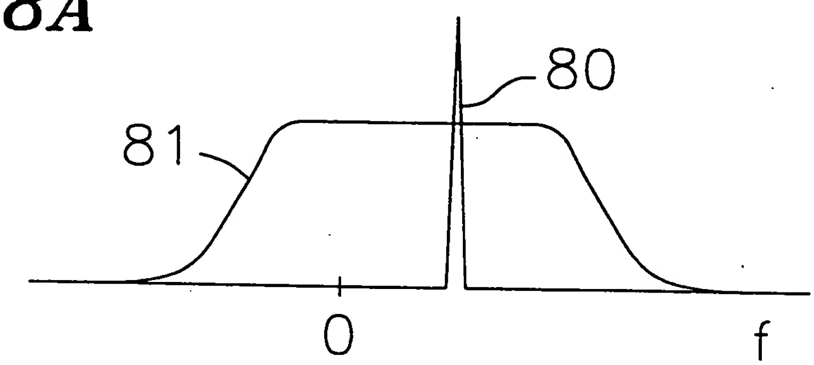


FIG. 8B

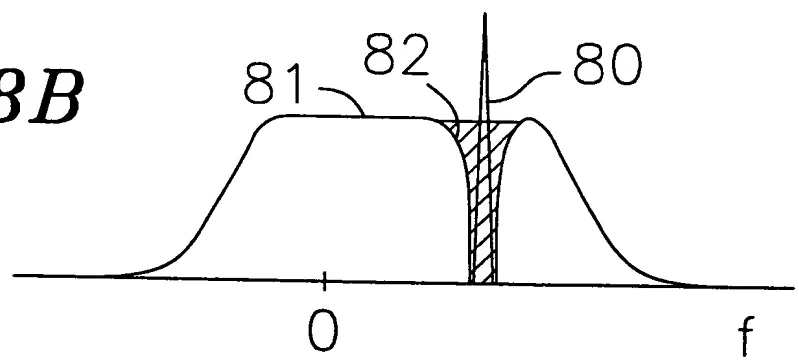
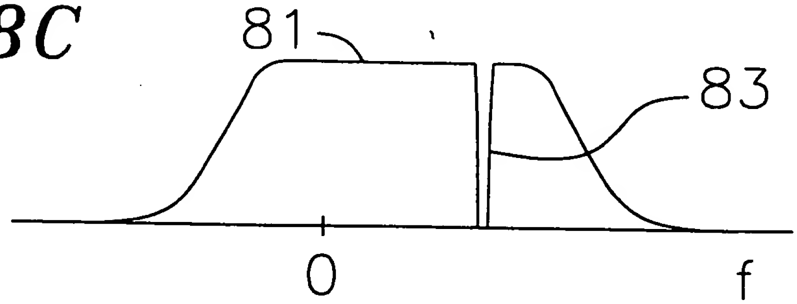


FIG. 8C



METHOD AND APPARATUS FOR REDUCING NOISE IN A BIDIRECTIONAL CABLE TRANSMISSION SYSTEM

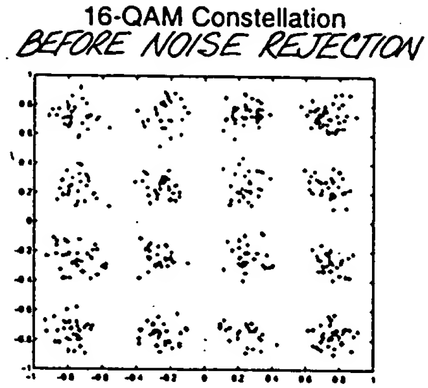


Fig. 9A

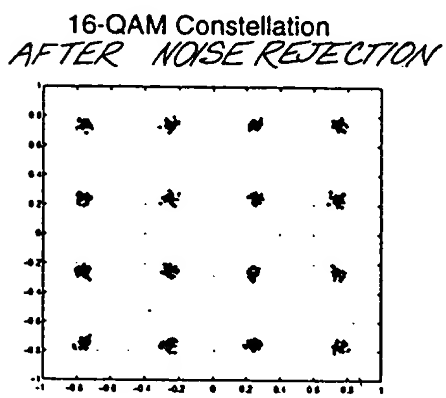


Fig. 9B

METHOD AND APPARATUS FOR REDUCING NOISE IN A BIDIRECTIONAL CABLE TRANSMISSION SYSTEM

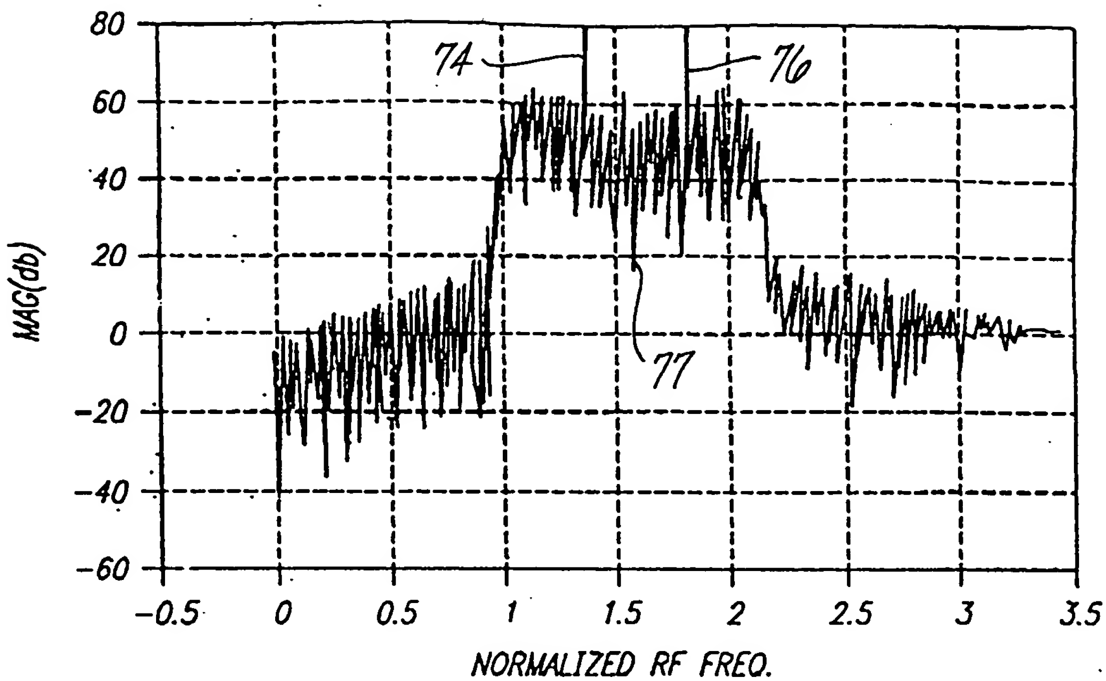


Fig. 10A

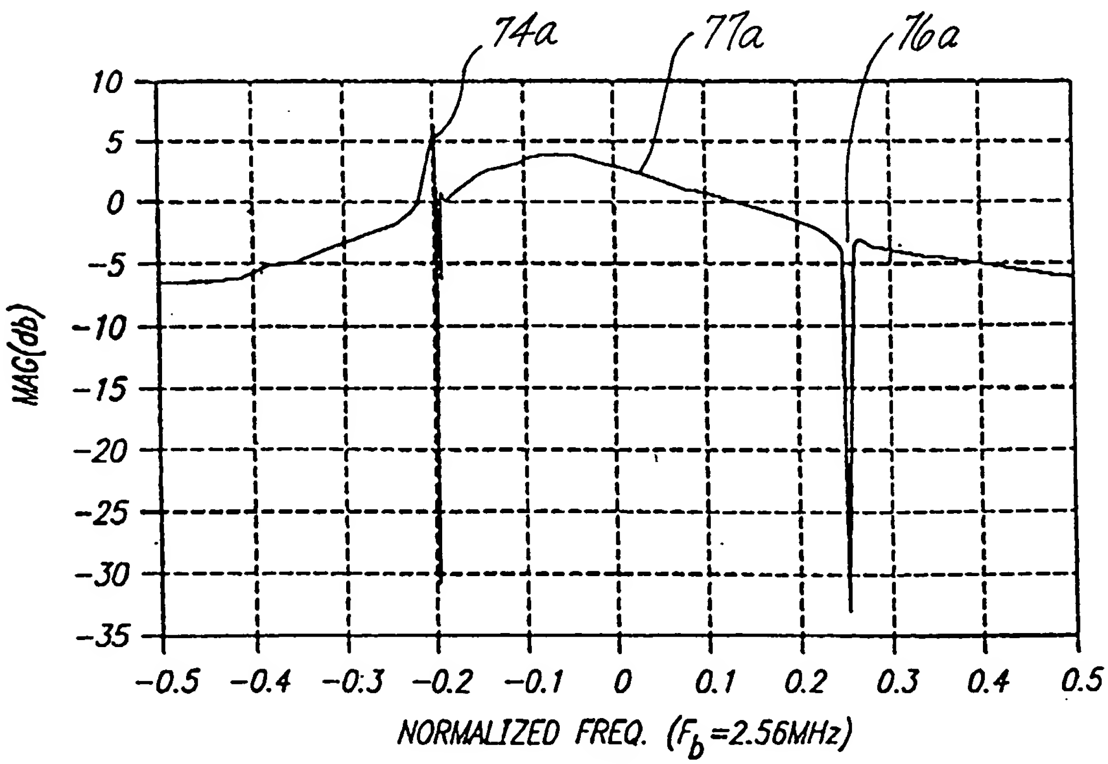


Fig. 10B

METHOD AND APPARATUS FOR REDUCING NOISE IN A BIDIRECTIONAL CABLE TRANSMISSION SYSTEM